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LEXINGTON, KENTUCKY

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 2, NUMBER 16
AUGUST 15, 1969

W69-06421 -- W69-06840

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD_____iii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER
Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE
Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION
Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL
Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION
Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING
Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA
Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS
Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES
Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION
Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

INTERMOLECULAR FORCES AND THE LIQUID STATE,
Purdue Univ., Lafayette, Ind.
C. R. Mueller.
Office of Saline Water Research and Development Progress Report No. 405. 1969. 34 p. OSW 14-01-0001-606.

Descriptors: *Liquids, *Molecular structure, *Statistical mechanics, Gases, Argon, Helium, Methane, Water, Theoretical analysis.
Identifiers: *Liquid state, *Intermolecular potentials, Molecular beams.

The intermolecular potential in the regions of interest to liquid state theory was studied by means of crossed molecular beams in order to provide data for the calculation of the statistical mechanical properties of liquids. The method involved the generation of two mechanically collimated beams of molecules which are forced to collide. By observing the angular distribution of the molecules scattered by the collisions the intermolecular forces were deduced. Differential cross section of helium-argon, argon-argon, neon-neon, methane-methane and water-water were determined. All of the systems indicated a common pattern in intermolecular potentials. The depth and position of the intermolecular potential minima were found to be similar to those obtained from the use of the Lennard-Jones 6-8 potential. The more common 6-12 potential did not even remotely fit the experiments. The potentials, however, were found to have a very broad forward bowl. This means that second and third nearest neighbors play very strong roles in the statistical mechanical theories. (Scott-Office of Saline Water)
W69-06838

02. WATER CYCLE

2A. General

DROUGHT IN THE NORTHEASTERN UNITED STATES,
New York Univ., N. Y. Dept. of Meteorology and Oceanology.
For primary bibliographic entry see Field 02B.
W69-06436

THE ABNORMALLY DRY WEATHER OF 1961-1966 IN THE NORTHEASTERN UNITED STATES,
Environmental Data Service, Silver Spring, Md.
For primary bibliographic entry see Field 02B.
W69-06437

FURTHER STUDIES OF DROUGHT OVER NORTHEASTERN UNITED STATES,
Weather Bureau, Washington, D. C. Extended Forecast Div.
For primary bibliographic entry see Field 02B.
W69-06438

SOME REMARKS ON THE PREDICTABILITY OF DROUGHT AND RELATED CLIMATIC ANOMALIES,
Environmental Science Services Administration, Silver Spring, Md.
For primary bibliographic entry see Field 02B.
W69-06439

EFFECTS OF THE DROUGHT ON WATER RESOURCES-SURFACE AND SUBSURFACE HYDROLOGY,
Geological Survey, Arlington, Va.
For primary bibliographic entry see Field 02B.
W69-06440

RELATION OF A HYDROLOGIC INDEX TO MEAN ANNUAL FLOW,
River Forecast Center, Harrisburg, Pa.
For primary bibliographic entry see Field 02B.
W69-06441

HYDROLOGIC CYCLE AS A CLOSED SYSTEM,
University Coll., Cork (Ireland).
James C. I. Dooge.
Bull Int Assoc Sci Hydrol, Vol 13, No 1, pp 58-68, Feb 1968. 11 p, 9 fig.

Descriptors: *Hydrologic cycle, *Water circulation, *Mathematical studies, *Systems analysis, Parametric Hydrology, Physics, Analytical techniques, Forecasting, Synthesis, Synthetic hydrology, Natural streams, Watersheds (Basons), Groundwater, Soil moisture, Storms.
Identifiers: *Lecture, Conceptual model.

Analytical and conceptual approach to the analysis of the hydrologic cycle, as a determinated system, is reviewed on the basis of earlier publications, and the main types of solutions for the analysis and synthesis of the combined deterministic systems are briefly summarized. The paper contains the following topic headings: the systems approach; hydrologic cycle; the problem of prediction; the problem of identification; the problem of simulation; non-linear methods; and review of present position. The article has 8 formulas. (Gabriel-USGS)
W69-06442

THE ANNUAL HEAT ENERGY TRANSFER ABOVE AND INSIDE ANTARCTICA BLUE ICE,
Melbourne Univ., Parkville (Australia). Dept. of Meteorology; and Melbourne Univ., Parkville (Australia). Antarctic Div.
For primary bibliographic entry see Field 02C.
W69-06480

RELATIONS BETWEEN GLACIER RUNOFF AND METEOROLOGICAL FACTORS OBSERVED ON AND OUTSIDE THE GLACIER,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau und Erbau.
For primary bibliographic entry see Field 02C.
W69-06481

DYNAMIC SIMULATION MODEL OF THE TRANSPIRATION PROCESS,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 02D.
W69-06504

A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
Hebrew Univ., Jerusalem (Israel).
D. Hillel, and E. Rawitz.
9th Int Congr Soil Sci, Trans, Vol 1, pp 303-311, Adelaide, Australia, 1968. 9 p, 2 fig, 4 tab, 3 ref.

Descriptors: Field investigations, *Runoff, Overland flow, Rainfall, Field tests, *Storm runoff, *Surface runoff, *Water harvesting, Paving, Arid climates, Rainfall-runoff relationships, Water conservation, Soils, Compaction, Water yield, *Water yield improvement, Induced benefits, Fuel oils, Salts, Cultivation, Infiltration, Foreign research.
Identifiers: Israel, *Negev (Israel), Surfacing, *Surface treatment, Aggregation.

Obtaining additional supplies of water by artificial inducement of runoff can be important in arid regions. Various surface treatments can affect the infiltration rate and stability of the soil and determine the quantity and frequency of runoff. Several treatments were compared in field runoff plots in Israel in which the rainfall pattern and runoff rates were monitored during 2 seasons. These treatments included: control, mechanical compaction, sodic dispersion, fuel oil, cultivation, and aggregation. An analysis is presented of the seasonal runoff potential and the performance of the various treatments, including: (1) total runoff yield, (2) runoff ratio, (3) average infiltration capacity, (4) relation of runoff yield to storm size, and (5) total seasonal erosion. The formation of a layer of stable aggregates reduced runoff to practically zero (especially during a drought season), whereas the formation of an artificial crust (fuel oil having the triple effect of sealing, waterproofing, and binding the soil surface) induced runoff in amounts exceeding 80% of seasonal rainfall. (USBR)
W69-06715

AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
American Society of Civil Engineers, Cambridge, Mass. Urban Hydrology Research Council.
For primary bibliographic entry see Field 04C.
W69-06770

A RIGID PLATE MODEL OF THE BAROMETRIC EFFECT,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02F.
W69-06775

EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Rezaul K. Bhuiya, and Vujica Yevjevich.
Colo State Univ Hydrol Pap No 31, Nov 1968. 23 p, 10 fig, 5 tab, 2 ref, 2 append. Grant No GK-1661 (NSF).

Descriptors: *Time series analysis, *Synthetic hydrology, *Rainfall-runoff relationships, *Stochastic processes, *Markov processes, Correlation analysis, Frequency analysis, Statistical methods, Forecasting, Streamflow forecasting.
Identifiers: *Hydrological time series, Time-series truncation, Normal process, Lognormal process.

The effects of constant value truncation on the dependence property of idealized hydrological time series are investigated. This analysis was carried out for dependent stochastic components, for periodic component and for the sum of stochastic dependent and periodic deterministic components of hydrological time series. The random elements of the process were considered for both normal and lognormal distributions. For all cases, the truncation is considered at a constant level. Analytical equations were developed in approximate forms for correlograms which express the dependence of the truncated time series. Computations of correlograms from these equations were made on a digital computer. Two series of daily river flows were used with the truncation at the mean flow to compare their correlograms with those of the original daily flow time series. Truncation at any constant level of a dependent random process reduces the dependence in sequence of a time series. The magnitude of the reduction depends on the constant of truncation. First autocorrelation coefficients of precipitation series in an arid region should be, in general and neglecting other factors which affect the dependence, less on the average than in a wet region, if the annual evaporation is assumed to be a constant. The truncation of a periodic process at a constant level reduces the amplitude of the correlogram while the period remains the same. It can also be said that the periodic truncation of a purely stochastic process makes the correlogram periodic. (Knapp-USGS)
W69-06789

REGIONAL HYDROLOGIC AREA STUDY AS AN ANALYSIS TOOL IN WEATHER MODIFICATION,
Sierra Hydrotechnology, Placerville, Calif.; and Atmospheric Water Resources Research, Fresno, Calif.

Jack F. Hannaford, and Merlin C. Williams.
Proc 36th Annu Meeting of Western Snow Conf, Apr 16-18, 1968, Lake Tahoe, Nev, pp 67-76, 1968. 10 p, 4 fig, 1 tab, 13 ref.

Descriptors: *Weather modification, *Cloud seeding, *Hydrologic data, Hydrologic aspects, Runoff, Streamflow, Water supply, Rainfall, Snowpacks.
Identifiers: *Sierra Nevada (Calif).

A regional hydrologic analysis of the southern and central Sierra Nevada from Bakersfield, California to Reno, Nevada was made to identify trends in runoff and to identify trends associated with weather modification activity. Most target areas show apparent increases in runoff during the period of modification operations. The pattern is clear even though increases may only be in the 5 to 10 percent range. This implies that Sierra weather modification projects have been successful, well targeted, and effective. There is an apparent area of downwind effect showing increases in runoff of a magnitude similar to that in the target areas. No peripheral or downwind effects indicating decreases in runoff were found which could be associated with the period of weather modification activity. It is recognized that rigorous statistical proof with the data in this analysis is a virtual impossibility. Apparent effects are small when related to overall discharge and potential measurement errors, so that detection with a suitable degree of statistical reliability basins may not be possible. However, an overall pattern is developing which appears consistent with findings of others in this and other areas. (Knapp-USGS)
W69-06805

THE USE OF ELECTRIC ANALOG MODELS IN HYDRODYNAMICAL STUDY OF THE ALSACE AQUIFERS (FRENCH),
Institut de Physique du Globe, Strasbourg (France).
For primary bibliographic entry see Field 02F.
W69-06806

ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
California Univ., Los Angeles. Dept. of Engineering.
For primary bibliographic entry see Field 02F.
W69-06813

QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
California Univ., Los Angeles. Dept. of Engineering; and Nevada Univ., Reno. Dept. of Water Resources.
John W. Labadie, William S. Butcher, and John A. Dracup.
Calif Univ Water Resources Center Rep, 1967. 15 p, 1 fig. OWRR Proj No B-028-CAL.

Descriptors: *Mathematical models, *Systems analysis, Optimization, Linear programming, Simulation analysis, Digital computers, Input-output analysis, Synthetic hydrology.
Identifiers: *Quasilinearization.

The use of quasilinearization in systems identification for the solution of complex hydrological problems is discussed. Quasilinearization is a powerful mathematical tool to solve many complex mathematical representations of hydrologic systems in the systems analysis or mathematical modeling techniques utilizing digital computers. Realistic models use systems of high-order, nonlinear, ordinary differential equations and partial differential equations. Solution of these equations may be found by finite difference techniques in digital computers. In modeling of hydrologic systems by quasilinearization, complex, nonlinear problems can be replaced by a successive approximation scheme which utilizes linear, first-order differential equations. A complete set of initial conditions need not be supplied. An algorithm is set up which can be used to converge to the optimal values of the parameters of the original nonlinear equations. (Knapp-USGS)
W69-06822

RAINFALL-RUNOFF RELATIONS FOR SOUTHEASTERN LOUISIANA AND SOUTHWESTERN MISSISSIPPI,
Geological Survey, Baton Rouge, La.
Anthony J. Calandro.
Louisiana State Dep Public Works Tech Rep No 2a, 1967. 61 p, 2 fig, 3 tab, 11 ref, append.

Descriptors: *Rainfall-runoff relationships, *Louisiana, *Mississippi, Hydrographs, Hydrograph analysis, Data collections, Rainfall, Runoff, Statistical models, Regression analysis, Antecedent precipitation, Duration curves, Runoff forecasting, Rain gages.
Identifiers: Thiessen methods.

A method for estimating storm runoff from rainfall records is presented for southeastern Louisiana and southwestern Mississippi. A rainfall-runoff relationship generally useful in the study area relates storm runoff to storm rainfall and the week of its occurrence. Values of weekly coefficients and exponents are tabulated. The standard error of estimate of this relationship for all storm is about 40%; for storm rainfalls greater than 4 inches, the standard error decreases to about 25%. With these limitations, the rainfall-runoff relations can also be used to distribute incremental rainfall excess with time. Records for 20 stream-gaging stations and 34 rainfall stations in the area studied were used to compute antecedent rainfall parameters, rainfall duration, total storm rainfall, and total runoff for 959 storm hydrographs. Graphical analysis indicates that regressions of rainfall versus runoff for each week of the year are good as or better than regressions involving parameters of antecedent conditions and rainfall duration for estimating storm runoff. Apparently, the week-of-year factor accounts for seasonal variations in duration and antecedent conditions, and use of the seasonal factor alone will provide useful estimates of storm runoff in the area studied. (Knapp-USGS)
W69-06829

IMPROVED TECHNIQUES FOR ESTIMATING RUNOFF WITH BRIEF RECORDS,
New South Wales Univ., Manly (Australia). Water Research Lab.
For primary bibliographic entry see Field 02E.
W69-06830

2B. Precipitation

DROUGHT IN THE NORTHEASTERN UNITED STATES,
New York Univ., N. Y. Dept. of Meteorology and Oceanology.
Jerome Spar.
Proc of Conf on Drought in Northeastern US, May 15-17, 1967 at Sterling Forest, N. Y. Mar 1968. 233 p.

Descriptors: *Droughts, *Precipitation (Atmospheric), *Water shortage, *Northeast U S, Meteorology, Climatology, Synoptic analysis, Statistical methods, Time series analysis, Rainfall, Streamflow forecasting, Water supply.
Identifiers: *Northeastern U S drought (1961-67).

A conference was held to discuss the drought of 1961-67 in the northeastern U. S. Topics discussed include economic aspects, water supply problems, the statistical aspects of northeastern U. S. precipitation, definition of droughts, hydrological aspects and effects on streamflow. Forecasting of rainfall, streamflow, and runoff, particularly long-range forecasting, was stressed. Analysis of meterological data suggests that precipitation frequency is less important than intensity as a drought factor, droughts are characterized by a mean upper trough position east of the normal position rather than by a low frequency of trough passages, westnorthwesterly storm tracks are more frequent than usual, southwesterly tracks are displaced east, and relative humidity is lower than usual in the lower atmosphere. (Knapp-USGS)
W69-06436

THE ABNORMALLY DRY WEATHER OF 1961-1966 IN THE NORTHEASTERN UNITED STATES,
Environmental Data Service, Silver Spring, Md.
Wayne C. Palmer.
Proc of Conf on Drought in Northeastern U S, May 15-17, 1967, Sterling Forest, N Y, pp 32-56, Mar 1968. 25 p, 12 fig, 1 tab, 4 ref.

Descriptors: *Drought, *Northeast U S, Climatology, Synoptic analysis, Statistical methods, Rainfall, Precipitation (Atmospheric), Streamflow.
Identifiers: Northeastern U S Drought (1961-67).

The history of the drought of 1961-67 in the northeastern U. S. is discussed. Unusually dry weather first appeared in the Hudson Valley in the fall of 1961. From there the drought spread and sporadically increased in severity until the shortages of urban and municipal water supplies became acute in many places by late 1964. After mid-1965 the heart of the drought area had shifted from the Hudson Valley to the Potomac Basic region. Maximum drought severity each year is shown by maps. Another map shows the drought of 1930-31 to have been more widespread and centered some 300 miles southwest of the center of this 1960's drought. The runoff deficit accounted for nearly 3/4 of the 5-year precipitation deficiency. The evapotranspiration deficit developed primarily during 1964 and 1966 and was considerably smaller than the runoff deficiency. A detailed analysis is given for determination of the likelihood that the 5 year of dry weather has finally given way to a period of near normal or wetter than normal weather. The conclusion was that by May 1967 the weather has been wet enough to justify at least a 50% likelihood that the drought had ended in September 1966. (Knapp-USGS)
W69-06437

FURTHER STUDIES OF DROUGHT OVER NORTHEASTERN UNITED STATES,
Weather Bureau, Washington, D. C. Extended Forecast Div.
Jerome Namias.
Proc of Conf on Drought in Northeastern US, May 15-17, 1967, Sterling Forest, N Y, pp 57-94, Mar 1968. 37 p, 19 fig, 1 tab, 13 ref.

Descriptors: *Droughts, *Northeast U S, *Climatology, Synoptic analysis, Statistical methods, Rainfall, Precipitation (Atmospheric), Winds, Meteorology, Anticyclones.
Identifiers: Northeastern U S drought (1961-67).

Records from New York Central Park Observatory were used to study the small-scale manifestations of the drought of 1961-67 in the Northeastern U. S. A long-term downward precipitation trend beginning in the 1920's or 1930's was found. This appears to be related to general circulation aberrations. Nationwide precipitation patterns were calculated from 59 yrs of precipitation records, and dry years in the northeast are usually also dry in the Southern Plains and wetter than usual in the Far West. It is suggested that when a prevailing upper-level trough is off the Atlantic coast in spring, leading to dry weather in the Northeast, another trough dominates the Western Plateau, causing intense frontal activity and showers. This system appears to be caused by the dominent influence of the upper-level anticyclone in the Southern Plains. (Knapp-USGS)
W69-06438

SOME REMARKS ON THE PREDICTABILITY OF DROUGHT AND RELATED CLIMATIC ANOMALIES,
Environmental Science Services Administration, Silver Spring, Md.

J. Murray Mitchell, Jr.
Proc of Conf on Drought in Northeastern US, May 15-17, 1967, Sterling Forest, NY, pp 129-159, Mar 1968. 31 p, 11 fig, 1 tab, 2 ref.

Descriptors: *Droughts, *Forecasting, *Climatology, Synoptic analysis, Statistical methods, Time series analysis, Meteorology, Rainfall, Precipitation (Atmospheric), Temperature, Winds.
Identifiers: *Drought prediction.

The general problem of climatic prediction is defined, and various conceivable approaches to prediction, in part physical and in part statistical, are distinguished. An analysis of the pattern of mean precipitation and temperature anomalies in the United States from 1962-1966 strongly suggests that the Northeast Drought was a regional manifestation of a general climatic fluctuation, associated with large-scale aberrations of the atmospheric circulation over North America. The Northeast Drought, unlike other recent U. S. droughts, was a comparatively cool one, especially during the winter and summer seasons when temperatures averaged below normal over most sections of the nation. On the basis of a power spectrum analysis of drought indices for Central Park, there seems to be very little hope that major droughts in the Northeast can be predicted years in advance by statistical means. Our best chance for reliable long-range drought prediction lies in the possibility of our gaining further insight into the physical causes of climatic fluctuation. (Knapp-USGS)
W69-06439

EFFECTS OF THE DROUGHT ON WATER RESOURCES-SURFACE AND SUBSURFACE HYDROLOGY,
Geological Survey, Arlington, Va.
Henry C. Barksdale.
Proc of Conf on Drought in Northeastern U S, May 15-17, 1967, Sterling Forest, N Y. pp 202-217, Mar 1968. 16 p, 4 fig.

Descriptors: *Droughts, *Water shortage, *Northeast U S, Water level fluctuations, Streamflow, Runnoff, Water storage, Water supply, Water yield, Hydrologic budget.
Identifiers: Drought criteria.

The relationship of climatic drought to the water resource deficit is discussed to establish reasonable criteria for the beginning and end of droughts. Insofar as water resources and water supplies are concerned, we may safely conclude that the drought is over if, during the coming growing season, normal or above-normal precipitation results in the maintenance of groundwater levels and streamflows above critical levels and certainly if, in the subsequent non-growing season, a more nearly complete recovery to normal levels and flows occur. The fact that the carryover of groundwater deficiency from 1966 to 1967 was absent in parts of the region and was less than in the preceding 2 years in other parts suggests that insofar as water resources are concerned the end of the drought is clearly within reach. It is not necessary for future above-normal precipitation to erase entirely the large cumulative deficiencies that have developed before we may feel that the drought is over from a water-resources viewpoint. It is impossible to store up any significant part of the water resources or water-supply needs that may have gone unsatisfied. (Knapp-USGS)
W69-06440

RELATION OF A HYDROLOGIC INDEX TO MEAN ANNUAL FLOW,
River Forecast Center, Harrisburg, Pa.
O. D. White.
Proc of Conf on Drought in Northeastern U S, May 15-17, 1967, Sterling Forest, NY, pp 218-228, Mar 1968. 11 p, 5 fig.

Descriptors: *Rainfall-runoff relationships, *Streamflow forecasting, Evapotranspiration, Soil moisture, Groundwater movement, Precipitation (Atmospheric), Infiltration, Antecedent precipitation, Statistical methods, River forecasting.
Identifiers: *Susquehanna River Basin, Hydrologic index.

A hydrologic index was developed for the Susquehanna Basin by logarithmic weighting of departures from normal of precipitation and soil moisture conditions. Because of the manner of weighting the variables, hydrologic departures from normal up to a year previous were given weight. The most recent events have progressively greater weights. Soil moisture was computed by using a storm rainfall-runoff procedure tested for use in the Susquehanna Basin. The soil moisture index is a measure of dryness as empirically defined by an antecedent precipitation index and a computed antecedent potential evapotranspiration index. March values of these indices were used to develop a relation between the HI for March and the annual mean flow of the basin. The average error for the dependent data was 1,300 cfs for the Susquehanna Basin and 700 cfs for a similar procedure developed for the Delaware Basin above Trenton, New Jersey. Average long-term flow for the Susquehanna above Harrisburg is 34,400 cfs and 11,800 cfs above Trenton. In every case, the forecast values were of the proper sign when compared to the long-term average flows. (Knapp-USGS)
W69-06441

PRECIPITATION AND BASE FLOW VARIABILITY,
Agricultural Research Service, Madison, Wis. Soil and Water Conservation Research Div.
Neal E. Minshall.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 137-145, 1968. 9 p, 7 fig, 1 tab, 3 ref.

Descriptors: *Base flow, *Surface-groundwater relationships, *Rainfall-runoff relationships, *Wisconsin, Hydrographs, Hyetographs, Groundwater, Low flow, Springs, Computers.
Identifiers: *Precipitation-base flow relations.

The effect of rainfall variability on the base flow of streams during a period involving only minor changes in vegetation cover is shown. Data from 133.5-hectare and larger watersheds in Wisconsin are presented to illustrate the relation between precipitation and base flow. Variations from the mean base flow on selected southwestern Wisconsin streams for the period 1940-1964 were correlated with precipitation trends. Accumulated deviations from the mean base flow bear a consistent relation to the accumulated deviation of precipitation, independent of the size of drainage area or magnitude of the mean annual base flow. Knowledge of the relation between precipitation and base flow permits estimating past base flows from the precipitation pattern. Precipitation is seldom normal for any extended period, but occurs in series of above- or below-normal yr. The lag between beginning of above-normal precipitation and base flow response may be several years, depending on the magnitudes preceding droughts and the precipitation departures. Reduction in base flow is almost immediate when precipitation drops below normal. A method is presented for estimating missing base flow records from the precipitation pattern. The relationship between average annual deviation of precipitation and base flow appears to be independent of the size of the drainage area. (Knapp-USGS)
W69-06443

ESTIMATION OF RAINFALL IN SPARSELY GAUGED AREAS,
Otago Univ., Dunedin (New Zealand). Dept. of Geography.
Peter Hutchinson.
Bull Int Ass Sci Hydrol, Vol 14, No 1, pp 101-119, Mar 1969. 19 p, 10 fig, 3 tab, 11 ref.

Descriptors: *Rain gages, *Correlation analysis, *Topography, Statistical methods, Gaging stations, Elevation, Meteorology, Mountains, Rainfall disposition.
Identifiers: *New Zealand.

In areas of high relief, topography strongly affects both the rainfall distribution and the variability of rainfall as measured by the correlation between pairs of points. To determine topographic effect, 2 New Zealand areas of different topography were compared. Coastal Otago has very strong relief, and Coastal Canterbury is flat to rolling. Correlation analyses were made on rain gage data of 1955-1965 in the 2 areas. The extreme values of the station coefficients of variability in Otago were 27.30 and 11.34. In Canterbury the extremes were 22.6 and 13.27. A second method of comparing the 2 areas was standard multiple regression in which the independent variables were topographic parameters. The results are shown graphically. On the average, correlations between any 2 Canterbury stations separated by as much as 60 mi are significant at the 99% level, while in Otago, the separation for 99% significance is only 29 mi and for 95% significance, separation is 50 mi. The results can be used to estimate the area described by each rain gage, to estimate rainfall at ungaged sites, and to establish correction factors to use with gages to make their readings representative of their surrounding areas. (Knapp-USGS)
W69-06773

FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL, U.S. COASTAL REGION, GULF OF MEXICO,
Weather Bureau, Silver Spring, Md. Office of Hydrology.
Hugo V. Goodyear.
Environ Sci Serv Admin Tech Rep WB-7, July 1968. 33 p, 54 fig, 3 tab, 7 ref.

Descriptors: *Rainfall disposition, *Rainfall intensity, *Tropical cyclones, *Frequency analysis, *Gulf Coastal Plain, Gulf of Mexico, Spatial distribution, Storms, Probability, Areal, Flooding, Structural design.
Identifiers: *Areal rainfall, Storm track, Landfall, Public Works, Storm frequency.

Results are presented of a rainfall frequency and areal distribution study of 46 well-developed tropical storms, basic data for which were collected during the 26-year period 1940-65. The storms entered the Gulf Coast between Apalachicola, Fla. and Brownsville, Tex.; rainfall investigation was for the 48-hour period from 24-hr before landfall to 24-hr after. A series of charts shows the spacial distribution of 12-, 24-, and 48-hr rainfall up to 100 mi inland and within 150 mi of either side of storm track. Other charts show distributions of 6- and 12-hr point rainfalls for 2, 10, 25, and 50% frequency in five 25-mi zones parallel to the coast and for 125 mi on either side of the storm track. Most probable time of maximum 6-hr point rainfall (29% probability) is during 6 hr before landfall. Combining probabilities of both time and space, a 21% probability exists that the max 6-hr point value will occur in the 12-hr period from 6 hr before to 6 hr after landfall and in a 75-mi square to the right of and landward from point of landfall. An area-point relation is provided for adjusting point rainfall values to average depths for areas up to 1000 sq mi. (Lang-USGS)
W69-06797

A UNIVERSAL SURFACE PRECIPITATION GAGE,
Agricultural Research Service, Boise, Idaho. Soil and Water Conservation Research Div.
Lloyd M. Cox, and W. Russell Hamon.
Proc 36th Annu Meeting of Western Snow Conf, Apr 16-18, 1968, Lake Tahoe, Nev, pp 6-8, 1968. 3 p, 5 fig.

Descriptors: *Snowpack, *Melt water, *Precipitation gages, *Measurement, *Water equivalent, Instrumentation, Mechanical equipment, Telemetry, Snow surveys, Snowfall, Snow management, Water management (Applied), Rainfall.
Identifiers: *Snow pressure recorder.

A total precipitation gage which weighs overlying snow and collects and measures water yield from

precipitation or snowmelt is described. The hydraulic weighing platform consists of a 5-ft dia platform supported by liquid-filled flexible tubing, surrounded by a 6-inch wide ring to provide a positive boundary for the system. An opening in the center of the platform collects water, which is measured in a tripping tank. Diagrams and specifications for building the system, and instructions for its operation are included. (Knapp-USGS)
W69-06804

RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
National Severe Storms Lab., Norman, Okla.
E. Kessler, and K. E. Wilk.
World Meteorol Organ/Int Hydrol Decade Proj Rep No 5, 1968. 46 p, 16 fig, 3 tab, 63 ref.

Descriptors: *Radar, *Remote sensing, *Precipitation (Atmospheric), *Measurement, *Rainfall, Precipitation intensity, Instrumentation, Meteorology, Runoff, Thunderstorms, Weather data.
Identifiers: *Radar storm-measurement.

Radar applications for the measurement of precipitation over an area are reviewed. Radar-sets with a beamwidth of 2 deg or less and a wavelength of 10 cm should provide improved measurements of area rainfall and more timely and comprehensive rainfall reports. However, practical use of the potential of radar for hydrologic work requires further examination of the correspondence between radar and raingage data, improved use of data-processing and communicating techniques, and development of improved means for measuring precipitation echoes in the presence of terrain echoes. A system for the display, processing and communication of accurate and suitably detailed weather radar information is being operated with the WSR-57 radar at the National Severe Storms Laboratory, Norman, Okla. The radar data can be presented in the usual manner on PPI displays and can also be quantized in small-range increments. In the latter case, the signal is averaged from pulse-to-pulse and is continuously recorded as a measure of the averaged reflectivity of each associated target volume. The averaged signals are displayed as contour-maps of target intensity on PPI scopes for photographic recording and they are also registered on magnetic tape in numerical form. The tape system is presently arranged to record in 2 and a half min the echo intensity in 8 categories at 14,400 locations between 20 and 130 nautical mi away. Computer programs are available to adapt the numerical data to a variety of specialized requirements. (Knapp-USGS)
W69-06812

CLIMATOLOGY STUDIES OF BAFFIN ISLAND, NORTHWEST TERRITORIES,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
R. G. Barry, and S. Fogarasi.
Inland Waters Br, Dep Energy, Mines and Resources Tech Bull No 13, 1968. 106 p, 9 fig, 5 ref.

Descriptors: *Synoptic analysis, *Climatology, *Data collections, Climatic data, Snow, Snowpacks, Glaciers, Precipitation (Atmospheric), Meteorological data.
Identifiers: *Canada, Baffin Island, Ice caps.

Vapor content and horizontal vapor transport over the Eastern Canadian Arctic were studied in a synoptic analysis of the Baffin Island region. Low temperatures cause low atmospheric moisture availability and consequent low winter precipitation, but there is no unique relation of maximum precipitation to moisture content or moisture transport. Precipitation maxima probably result from storm frequency maxima. Depressions moving northward toward Baffin Bay are probably a major source of moisture transport for southern and eastern Baffin Island. Mean monthly moisture content, mean monthly humidity, mean monthly vector transport and eddy vector transport, zonal transport and pressure-snowfall relations are shown in summary form by contour maps. (Knapp-USGS)
W69-06814

2C. Snow, Ice, and Frost

THE MECHANICAL PROPERTIES OF SINGLE CRYSTALS OF ICE AT LOW TEMPERATURES,
Birmingham Univ. (England). Dept. of Physics.
S. J. Jones, and J. W. Glen.
Comm of Snow and Ice, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Sci Hydrol, Pub No 79, pp 326-340, 1967. 15 p, 13 fig, 12 ref.

Descriptors: *Ice, *Plastic deformation, *Flow, Physical properties, Rheology, Temperature, Pressure, Mechanical properties, Plasticity, Strain, Stress, Crystal growth.
Identifiers: Dislocation (Crystallographic).

The mechanical properties of single crystals of ice were investigated at various temperatures down to -90 deg C. Two methods were used: creep tests in tension and constant strain-rate tests in compression. Results show that the activation energy for creep varies with temperature from 0.41+ or - 0.03 eV between -50 deg C and -90 deg C to 0.68+ or - 0.04 eV between -50 deg C and - 10 deg C. The glide direction in ice is confirmed to be the (11-20) crystallographic direction. The yield point phenomenon observed in the constant strain-rate tests is discussed in terms of the theory of the multiplication of dislocations. Experimental curves compare well with computed curves. Small amounts of HF dissolved in ice cause a pronounced softening. (Knapp-USGS)
W69-06474

DEFORMATION OF POLYCRYSTALLINE ICE UNDER COMBINED UNIAXIAL AND HYDROSTATIC PRESSURE,
Federal Inst. for Snow and Avalanche Research, Weissfluhjoch-Davos (Switzerland).
R. Haefeli, C. Jaccard, and M. De Quervain.
Comm of Snow and Ice, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 79, pp 341-344, 1967. 4 p, 2 fig, 1 tab.

Descriptors: *Ice, *Plastic deformation, *Flow, *Hydrostatic pressure, Physical properties, Rheology, Temperature, Pressure, Mechanical properties, Plasticity, Strain, Stress.
Identifiers: Ice deformation, Uniaxial stress.

A cylindrical polycrystalline ice sample is deformed under an uniaxial load of 0.8 bars and a hydrostatic pressure of 295 bars at temperatures of -5.9 deg and -8.1 deg C. The creep rate is increased by the hydrostatic pressure at constant temperature, but reduced again below its original value if the temperature is dropped at the rate of the depression of the pressure melting point. (Knapp-USGS)
W69-06475

THE IMPORTANCE OF THE HYDROGEN ATOM ARRANGEMENT IN DETERMINING HOW ICE CAN DEFORM PLASTICALLY,
Birmingham Univ. (England). Dept. of Physics.
J. W. Glen.
Comm of Snow and Ice, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 79, pp 352-355, 1967. 4 p, 2 fig, 3 ref.

Descriptors: *Ice, *Plastic deformation, *Crystallography, Rheology, Physical properties, Thermodynamics, Plasticity, Strain.
Identifiers: Lattice defects, Point dislocations, Crystallographic slip.

In the structure of ice, the oxygen atoms are arranged crystallographically, but the hydrogen atoms are not. This means that if ice were deformed plastically by slip without any other process occurring, electrical point defects would have to be created, and the energy of these is such that the stress required to make them is far higher than the observed stress required to deform ice. Thus the ordinary slip process could not occur in ice unless some mechanism is available to re-orient the hydrogen atoms, such as the presence of mobile point defects. This necessity explains why creep in ice is as slow as it is, and also why hydrogen fluoride impurity in ice, which introduces such point defects, has such a large effect on the creep rate of ice, particularly at low temperatures. (Knapp-USGS)
W69-06476

THE METAMORPHISM OF WET SNOW,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
Gorow Wakahama.
Comm of Snow and Ice, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 79, pp 370-379, 1967. 10 p, 9 fig, 1 tab, 1 ref.

Descriptors: *Snow, *Crystallization, *Melting, Crystals, Snowmelt, Melt water, Permeability, Porosity, Runoff, Ice.
Identifiers: Snow metamorphism, Wet snow.

In order to study the metamorphism of wet snow, a block of snow was placed in a thermally insulated box and maintained at 0 deg C for a long time. The microscopic changes occurring in the texture of snow were examined by the use of thin sections cut every other day from the block. Four series of experiments were carried out, using (1) dry snow, (2) snow wetted by adding a small amount of water, (3) snow immersed in water of 0 deg C, (4) snow immersed in water of 0 deg C and loaded with a weight. It was found that ice grains composing the snow grew rapidly in size in the case (3), while they grew slowly in the cases (1) and (2). In the case, (4) snow was transformed into ice within a week. (Knapp-USGS)
W69-06477

LIQUID PERMEABILITY OF SNOW,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
Daisuke Kuroiwa.
Comm of Snow and Ice, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 79, pp 380-391, 1967. 12 p, 8 fig, 2 tab, 3 ref.

Descriptors: *Permeability, *Snow, *Permeameters, Infiltration, Physical properties, Hydrologic properties, Flow, Porosity, Saturated flow, Structure.
Identifiers: Kerosene permeameters, Falling-head permeameters, Snow structure, Grain size.

In order to measure the liquid permeability of snow, 3 types of kerosene permeameters were designed for low, medium, and high density snow. The measurements were conducted on natural snow cover and artificially compressed snow, and correlation between kerosene permeability and porosity was investigated for wide range of porosity. The principle of these permeameters is analogous to the ordinary falling-head method used in soil engineering. The reproducibility of the kerosene permeability (k) was carefully investigated by repeating many tests on the same sample of snow. In the case of low density snow, less than 0.36 g/cu cm, a 10-15% difference was found between the k values for the first and second tests and those of subsequent tests. This difference is presumably caused by the compression of the low density snow specimen by the kerosene pressure. The horizontal permeability was larger than the vertical permeability. The relation between k and porosity of snow showed a wide scatter in the range of porosity 0.45 to 9.0. The values of k for fine-grained snow varied between 0.1 and 1.0 cm/sec, while k values for coarse-grained snow varied between 1.0 and 4.0 cm/sec. When porosity of snow was reduced from 0.4 to 0.05, the value of k decreased logarithmically from 0.1 to 10 minus 4 cm/sec. (Knapp-USGS)

W69-06478

THE METAMORPHISM OF DRY SNOW AT A UNIFORM TEMPERATURE,
Wash Univ., Seattle. Dept. of Atmospheric Sciences.
P. V. Hobbs.
Comm of Snow and Ice, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub no 79, pp 392-402, 1967. 11 p, 2 fig, 14 ref. Grant Nos GP-3809 (NSF), GA-780 (NSF).

Descriptors: *Snow, *Crystallization, *Physical properties, Crystallography, Diffusion, Density, Pressure, Temperature, Melting, Freezing.
Identifiers: Snow metamorphism, Recrystallization, Dry snow.

The mechanisms by which the strength and density of old dry snow at a uniform temperature increase with time are discussed. It is concluded from theoretical and experimental studies that once the snow particles have assumed spherical shapes the dominant mechanism controlling the increase in the area of the ice bonds between grains, and therefore the strength of snow, is the transfer of material by diffusion through the vapor phase. The area of the ice bonds increases to the 2/5 power of t, where t is the age of old snow. In the absence of appreciable overburden pressure or temperature gradients, the increase in the density of old snow appears to be determined by the transfer of material by volume diffusion through the ice. Under these conditions the density also increase as the 2/5 power of t. The effects of time, grain size, and temperature of the strength of old snow are predicted theoretically and the results compared with experimental measurements. (Knapp-USGS)
W69-06479

THE ANNUAL HEAT ENERGY TRANSFER ABOVE AND INSIDE ANTARCTICA BLUE ICE,
Melbourne Univ., Parkville (Australia). Dept. of Meteorology; and Melbourne Univ., Parkville (Australia). Antarctic Div.
G. Weller.
Comm of Snow and Ice, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 79, pp 417-428, 1967. 12 p, 3 fig, 6 tab, 8 ref.

Descriptors: *Climatology, *Glaciers, *Heat transfer, Heat flow, Antarctic, Heat budget, Solar radiation, Winds, Air temperature, Geothermal studies, Conduction, Convection, Storage, Density.
Identifiers: *Antarctic ice cap, Continental ice sheets, Eddy transfer (Heat).

The heat energy fluxes at an ice surface in the Antarctic coastal ablation zone were measured and a Fourier analysis was carried out on the monthly mean values of all components. The energy transfer in the ice was measured and analyzed by computing the amplitudes of the radiative and conductive heat fluxes at various depths in the ice. In the surface heat budget the eddy heat transfer to the surface is the largest component with an annual mean value of 60 cal per sq cm per day and an annual amplitude of 50 cal per sq cm per day balancing the annual mean heat energy loss of 22 cal per sq cm per day by radiation and 38 cal per sq cm per day by evaporation and melting at the ice surface. The annual amplitude of the conducted heat flux through the surface of the ice resulting from changes in the net heat storage is approximately 30 cal per sq cm per day or 1/3 of the amplitude of the radiative net short wave flux through the surface. The annual temperature wave at the surface and the absorbed radiation contribute about equally to net changes in stored heat. At 4 metres depth the amplitude of the radiative flux is 1/3 of that of the conductive flux and the contribution of absorbed radiation to net changes in stored heat is still 15%. The mean annual value of the absorbed short wave radiation of 90 cal per sq cm per day balances heat losses by conduction to give zero annual net heat storage in the ice. (Knapp-USGS)
W69-06480

RELATIONS BETWEEN GLACIER RUNOFF AND METEOROLOGICAL FACTORS OBSERVED ON AND OUTSIDE THE GLACIER,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau und Erbau.
Herbert Lang.
Comm of Snow and Ice, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 79, pp 429-439, 1967. 11 p, 5 fig, 11 ref.

Descriptors: *Glaciers, *Meteorology, *Hydrologic budget, *Heat budget, Regimen, Runoff, Ablation, Melting, Solar radiation, Temperature, Wind, Vapor pressure, Precipitation (Atmospheric), Regression analysis, Statistical methods.
Identifiers: *Alpine glacier budget, Aletschgletscher.

A heat balance and runoff study was made on the lower part of the Aletschgletscher in July and August 1965. The data were treated by multiple regression analysis. Meltwater runoff from a small area of the glacier surface was taken to be representative of heat balance at that point, while runoff from the whole Aletschgletscher basin is used as a measure of melting of the entire glacier area. Meteorological data collected were global radiation, temperature, vapor pressure, wind, and precipitation. Regression analysis showed that for hourly means in the small area regression, radiation was the most important factor. It made no difference whether temperature and vapor pressure were taken on the glacier or nearby. Temperature taken near the glacier gives a better correlation than temperature on the glacier. For daily means in the small area regression, the on-glacier temperature is better than off-glacier temperature or global radiation. In the multiple correlation, vapor pressure has great influence, wind speed is negligible, and on-glacier measurements correlate best with runoff. For the whole glacier off-glacier temperature is the most important factor, and temperature, vapor pressure, and precipitation give as good a regression as using all the factors. (Knapp-USGS)
W69-06481

A TEMPERATURE PROFILE THROUGH THE MEIGHEN ICE CAP, ARCTIC CANADA,
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
W. S. B. Patterson.
Comm of Snow and Ice, Proc Gen Assembly of Bern (Sept-Oct 1967), Int Ass Sci Hydrol, Pub No 79, pp 440-449, 1967. 10 p, 2 fig, 1 tab, 13 ref, 1 append.

Descriptors: *Temperature, *Glaciers, Boreholes, Geothermal studies, Climatology, Regimen, Ablation, Heat budget, Air temperature, Solar radiation.
Identifiers: *Meighen Ice Cap (Canada), Glacial temperature profiles, Mass balance.

Temperatures were measured in a 121 m borehole through the 35 sq km ice cap on Meighen Island, Arctic Canada. The ice cap is virtually stagnant; thus advection of ice is not a factor in determining the temperature distribution. Temperatures below 10 m depth were in the range -16 to -18 deg C. Below 100 m, temperature varied linearly with depth at a rate which corresponds to a geothermal heat flux of 0.8 millionths of a cal per sq cm per sec. The shape of the temperature - depth curve over the range 20 to 100 m can be explained by assuming that (1) the mean annual temperature at the surface has decreased by some 1.5 deg C since the year 1940 and (2) the mean annual surface temperature was increasing during the period 1880-1940, the total increase being about 3.5 deg C. (Knapp-USGS)
W69-06482

A SYSTEM FOR MAKING REMOTE AND UNDISTURBED MEASUREMENTS OF SNOW SETTLEMENT AND TEMPERATURES,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
Robert H. Swanson.
Proc 36th Annu Meeting of Western Snow Conf, Apr 16-18, 1968, Lake Tahoe, Nev, pp 1-5, 1968. 5 p, 7 fig, 6 ref.

Descriptors: *Snow management, *Snowpacks, *Snow surveys, *Instrumentation, Depth, Snowfall, Density stratification, Snow management, Remote control, Mechanical equipment, Telemetry.
Identifiers: Snow settlement, Snow temperature.

Snow settlement and temperature are measured by thermistors mounted on platters dropped onto snow by remote control. Platter height is measured by the resistance of a vertical wire down which the platters slide. Several platters are stored above the snow to be released one at a time for successive settlement measurements. The equipment and its operation are described in detail. (Knapp-USGS)
W69-06803

A UNIVERSAL SURFACE PRECIPITATION GAGE,
Agricultural Research Service, Boise, Idaho. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02B.
W69-06804

RECENT HISTORY OF GULKANA AND COLLEGE GLACIERS, CENTRAL ALASKA RANGE, ALASKA,
Arizona State Univ., Tempe. Dept. of Geology.
Richard D. Reger.
J of Geol, Vol 76, no 1, pp 2-16, Jan 1968. 15 p, 5 fig, 2 plate, 36 ref.

Descriptors: *Glaciers, *Regimen, *Alaska, Climatology, Water sources, Precipitation (Atmospheric), Melting, Hydrologic budget.
Identifiers: Glacial history (Alaska), Central Alaska Range.

The Recent moraines of Gulkana and College Glaciers lie above tree line in the central Alaska Range and were dated by lichenometry as being deposited by advances possibly in 1580 and 1650, and in 1830 and 1875. Older moraines are also present, but could not be dated by this method. Gulkana Glacier advanced in 1580, depositing moraines which were partly buried by moraines of later advances. No correlative advance apparently occurred at College Glacier. Gulkana Glacier readvanced in 1650 and overrode the 1580 terminal moraine. In 1830 Gulkana Glacier advanced to a position 2.5 km beyond the 1962 ice terminus, overriding 1650 moraines, spilling onto the Wisconsin glacial floor, damming College Creek, and partly blocking West Gulkana Creek canyon. With the blocking of College Creek, and a small ice-dammed lake formed and was rapidly filled with outwash material from College Glacier. College Glacier also advanced in 1830 to a position 1.7 km beyond its 1962 position. After a period of thinning and retreat, Gulkana Glacier advanced in 1875; no equivalent advance is recorded for College Glacier. The 1875 advance again blocked College Creek, and another small ice-dammed lake formed. Since 1875, both glaciers have rapidly thinned and retreated, indicating they have negative economies. (Knapp-USGS)
W69-06808

2D. Evaporation and Transpiration

DYNAMIC SIMULATION MODEL OF THE TRANSPIRATION PROCESS,
Oregon State Univ., Corvallis.
K. B. Woo, L. Boersma, and L. N. Stone.
Water Resources Res, Vol 2, No 1, pp 85-97, 1st Quarter 1966. 13 p, 8 fig, 20 ref.

Descriptors: *Analog computers, *Simulation analysis, *Transpiration, Soil moisture, Soil-water-plant relationships, Mathematical models, Flow rates, Dynamics, Storage capacity.
Identifiers: System gain, Differential equations.

A simulation model of the transpiration process was presented, based on Ohm's law describing water flow into, through, and out of plants. The hypothesis was expanded to include an analogous storage factor to deal with the dynamic flow of water in the plant. A set of differential equations and transfer functions was expressed in terms of water suction variables. The dynamic description of the water status in the plant was completed by introducing the system gain, which was a function of the transpiration rate and soil-water condition. The entire system was simulated on an analog computer; its dynamic characteristics were investigated with consideration of various environmental effects. (Gysi-Cornell)
W69-06504

EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
Clemson Univ., S. C.
For primary bibliographic entry see Field 02G.
W69-06514

THE HYDROLOGIC IMPORTANCE OF TRANSPIRATION CONTROL BY STOMATA,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
Richard Lee.
Water Resources Research, Vol 3, No 3, pp 737-752, 3rd Q 1967. 8 fig, 9 tab, 34 ref.

Descriptors: *Leaves, *Transpiration control, *Water yield improvement, *Stomata, *Diffusion, Water vapor, Photosynthesis, Temperature, Carbon dioxide, Hydrologic aspects, Pores, Resistance, Evapotranspiration, Plant physiology, Water loss, Winds, Conductivity, Equations.

Discussed in this report were the concept that a transpiration decrease in leaves was not caused by the extra mechanical obstruction to the passage of water vapor, and its potential significance in management of vegetation to increase water yields. Stomatal transpiration was considered as it was affected by the dimensions of the leaf and stomata, stomatal density and movements, external resistances in the diffusion path and thermodynamic considerations. Conclusions were based on results of laboratory tests of water vapor diffusion through tubes, through single pore and multipore membranes and on diffusion theory. Diffusive conductance of small pores was more sensitive to diameter changes at the larger apertures, thus permitting carbon dioxide exchange for photosynthesis without dehydration of the leaf mesophyll. Characteristic diffusion coefficients for leaf types, based on a study of leaf microstructure, physiology, and seasonal variation, were a basis for cover-type conversions or biochemical controls to reduce water loss in arid climates. (Blecker-Ariz)
W69-06520

ESTIMATING PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
Utah Water Research Lab., Logan.
Jerald E. Christiansen.
Irrigation and Drainage Specialty Conference, Los Vegas, Nevada, pp 193-234, Nov 2-4, 1966. 39 p, 16 tab, 33 ref.

Descriptors: *Evaporation, *Evapotranspiration, *Evaporation pans, *Climatic data, *Estimating, Utah, Estimating equations, Equations, Monthly, Correlation analysis, Elevation, Humidity, Solar radiation, Temperature, Wind velocity.
Identifiers: *Formulae, Coefficients.

Pan evaporation formulas, which have been developed at Utah State University, provide a satisfactory procedure for estimating pan evaporation when such data are not available. The tables presented make application of the revised pan evaporation formula very convenient. Where climatic data are available, pan evaporation can be estimated with a fair degree of accuracy for practically all climatic conditions. Use of tables for the coefficients and their logs makes the pan evaporation formula easy to apply. The formula is useful when all of the climatic factors included are not available. (Blecker-Ariz)
W69-06522

TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
Cairo Univ. (Egypt). Dept. of Botany.
A. A. Abd El Rahman, and K. H. Batanouny.
J of Ecology, Vol 53, No 2, pp 267-272, July 1965. 3 fig, 1 tab, 14 ref.

Descriptors: *Transpiration, *Desert plants, *Environmental effects, *Evaporation, *Microenvironment, Moisture deficit, Atmosphere, Moisture stress, Soil moisture, Soil-water-plant relationships, Weight, Water utilization, Fluctuation, Droughts, Diurnal, Humidity.
Identifiers: *Egypto-Arabian desert, United Arab Republic, Evaporimeters.

Transpiration rate of two common desert plants (Zygophyllum coccineum and Zilla spinosa of the Egypto-Arabian desert was studied in different microhabitats to see how far their environmental conditions influenced transpiration intensity. Transpiration intensity was compared in different combinations of atmospheric and soil moisture stresses. The method used for measuring rate of transpiration was that of rapid weighing of detached parts. Early reduction in transpiration rate in the plateau and the first terrace represented an economy in water use during a time of high evaporation rate, but in the shade it may be referred to general decline in evaporating factors. Highest maximum and mean transpiration rates were attained under conditions of atmospheric drought and favorable soil moisture. When atmospheric drought was associated with soil drought, maximum and mean transpiration rates in the two species were much lower. (Blecker-Ariz)
W69-06526

EVALUATION OF SOME PRACTICAL METHODS OF ESTIMATING EVAPOTRANSPIRATION IN ARID CLIMATES AT LOW LATITUDES,
Cornell Univ., Ithaca, N. Y. School of Civil Engineering.
Wilfried Brutsaert.
Water Resources Research, Vol 1, No 2, pp 187-191, 2nd q, 1965. 2 tab, 12 ref.

Descriptors: *Evapotranspiration, *Arid climates, *Estimating, *Weather data, *Latitudinal studies, Evaporation, Air temperature, Humidity, Dry seasons, Wet seasons, Evaporation pans, Equations, Measurement, Lysimeters, Consumptive use, Monthly, Diurnal.
Identifiers: Eastern Congo Republic, Blaney-Criddle formula, Blaney-Morin formula, Penman's equation, Equator, Thornthwaite formula.

A comparison was presented of monthly evapotranspiration data obtained by methods that were used at low latitudes. The valley of the Ruzizi in the Eastern Congo Republic was used for the study area. Best agreement was noted for evaporation when measured with a pan and calculated with Penman's equation. Equations for predicting evapotranspiration based on temperature only, such as those of Blaney-Criddle and of Thornthwaite, may yield good results in arid climates as long as there is a well defined wet winter-dry summer cycle. Equations such as Blaney-Morin's, which include the effect both of temperature and humidity of the air, showed great promise for equatorial climatic conditions. (Blecker-Ariz)
W69-06530

EVAPORATION REDUCTION ON LARGE RESERVOIRS,
Utah State Univ., Logan; Utah Engineering Experiment Station, Salt Lake City; and Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 03F.
W69-06531

TRANSPIRATION REDUCTION BY SURFACE FILMS,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Meteorological Physics.
For primary bibliographic entry see Field 03F.
W69-06532

PHOTOSYNTHESIS AND WATER USE BY SALTCEDAR,
Geological Survey, Lubbock, Tex.
For primary bibliographic entry see Field 03B.
W69-06771

ON THE ESTIMATION OF EVAPORATION FROM A LAND SURFACE,
Liu Chen-hsing.
Acta Meteorologica Sinica, Peking, China, Vol 27, No 4, pp 337-343, 1956. 7 p, 1 fig, 1 tab, 6 ref.

Descriptors: *Evaporation, *Forecasting, Energy budget, Heat balance, Water balance, Equations.
Identifiers: Bagrov equation (Evaporation).

A modification of the evaporation equation of Bagrov is suggested for simplicity of computation and extension of the range of its applicable physical conditions. Comparison of isopleths plotted by both methods shows values below those of Bagrov for values of the ratio precipitation/evaporation potential less than 1.10, and higher than those of Bagrov for values above 1.10. (Knapp-USGS)
W69-06833

2E. Streamflow and Runoff

INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO,
Geological Survey, Washington, D. C.
C. A. Thomas.
Idaho Dep Reclam Water Inform Bull No 9, Apr 1969. 39 p, 15 fig, 8 ref.

Descriptors: *Inflow, *Discharge (Water), *Springs, *Idaho, Streams, Streamflow, Water quality, Hydrogeology, Hydrologic data, Data collections.
Identifiers: *Snake River Plain, Snake River (Idaho).

The principal source of inflow to the Snake River, Idaho is the springs along the north bank of the river. The springs discharge water from the Snake Plain aquifer, which underlies most of the Snake River Plain. The hydrologic and geographic features of the supply are shown on maps and graphs and are described briefly. Generally, inflow to the study reach fluctuates in a narrow range. Total inflow during the water years 1910-66 averaged 7,400 cfs or 5.4 million acre-ft per year; an estimated 5,900 cfs issued from springs along the north bank, and about 1,500 cfs was contributed from all south-side sources. Inflow to the reach increased from 5,500 cfs in 1910 to 8,300 cfs in 1953, as a result of increased irrigation. However, starting in 1953, pumping from the Snake Plain aquifer and a decrease in recharge reduced the inflow to about 7,000 cfs by 1962. An increase in recharge raised the inflow to about 7,800 cfs in 1965. Excellent forecasts of the spring flows and of the total inflow to the reach can be made. Chemical analyses of the spring waters showed that dissolved solids range from 382 mg/l in Blue Lakes Spring to 217 mg/l in Riley Creek. Dissolved solids in the flows in the south-side channels averaged 560 mg/l. The composite dissolved solids of the total inflow was found to be 328 mg/l. (Knapp-USGS)
W69-06427

RESPONSE OF BUBBLE-GAGE SERVOMANOMETERS TO OSCILLATIONS IN WATER LEVEL,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07C.
W69-06434

WATER-RESOURCES APPRAISAL OF THE LOWER MOAPA-LAKE MEAD AREA, CLARK COUNTY, NEVADA,
Geological Survey, Carson City, Nev.
For primary bibliographic entry see Field 02F.
W69-06435

RELATION OF A HYDROLOGIC INDEX TO MEAN ANNUAL FLOW,
River Forecast Center, Harrisburg, Pa.
For primary bibliographic entry see Field 02B.
W69-06441

PRECIPITATION AND BASE FLOW VARIABILITY,
Agricultural Research Service, Madison, Wis. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02B.
W69-06443

FLOOD INUNDATION AND EFFECTS OF URBANIZATION IN METROPOLITAN CHARLOTTE, NORTH CAROLINA,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 04C.
W69-06445

EXTENSIONS OF STREAMFLOW RECORDS IN UTAH,
Geological Survey, Washington, D. C.
J. K. Reid, L. E. Carroon, and G. E. Pyper.
Utah State Dep of Natur Resources Tech Publication No 20, 1968. 110 p, 6 fig, 7 reg, append.

Descriptors: *Streamflow, *Data collections, *Utah, Statistical methods, Correlation analysis, Hydrologic data, Stream gages, Hydrographs, Water management (Applied).
Identifiers: Streamflow record extension.

Long-term data on streamflow at selected short-term gaging stations in Utah are tabulated. The records of streamflow at the short-term or secondary gaging stations are extended on the basis of a graphical correlation with concurrent records at long-term or primary gaging stations. The data presented consist of records of runoff at the short-term stations summarized on a monthly and yearly basis; these data include the actual short-term records and the correlative estimates of runoff. Methods and information are included to enable the reader to make further extensions of runoff records. The standard error of estimate for correlations used is 30% or less, and the coefficient of correlation is at least 0.8. Streamflow information is thereby obtained that is believed to be more representative of the long-term runoff than is an actual short-term record. The optimum period of concurrent record needed in Utah for a reliable correlation is about 15-20 yr. Extensions of record for low-flow and flood-frequency studies usually cannot be obtained from correlations. Much of this information could be collected economically by converting short-term stream-gaging stations to partial-record stations after a satisfactory correlation with a long-term station has been obtained. (Knapp-USGS)
W69-06447

WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, Washington, D. C.
P. C. Reed, J. C. Scott, H. G. Golden, and J. R. Avrett.
Geol Surv of Ala Basic Data Rep and Map No 75, 1968. 24 p, 3 fig, 1 map, 4 tab, 5 ref.

Descriptors: Water resources, *Surface waters, *Groundwater, *Alabama, Water wells, Streamflow, Water yield, Water quality, Water levels, Hydrologic data, Data collections, Aquifers, Hydrogeology.
Identifiers: Conecuh County (Ala).

The water availability in Conecuh County, Alabama is described by maps showing streamflow, areas of potential well yields of over 1 mgd from 2 major aquifers, depth to water, and thickness and depth of the major aquifers. A compilation of basic data includes well depths, aquifer tapped, water level, and construction data for 264 wells. Chemical analyses of well, stream, and spring waters are also compiled. In most of the county, water supplies are adequate to meet any forecast demand and are of good enough quality for most uses. (Knapp-USGS)
W69-06451

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02F.
W69-06452

FLOOD PLAIN INFORMATION, WILSON CREEK AND TRIBUTARIES, SPRINGFIELD, MISSOURI-PART 1.
Corps of Engineers, Little Rock, Ark.
For primary bibliographic entry see Field 04A.
W69-06467

FLOOD PLAIN INFORMATION, ROCKY RIVER IN CITIES OF ROCKY RIVER AND LAKEWOOD, CUYAHOGA COUNTY, OHIO.
Corps of Engineers, Buffalo, N. Y.
For primary bibliographic entry see Field 04A.
W69-06468

FLOOD PLAIN INFORMATION, WALLA WALLA RIVER TRIBUTARIES IN THE VICINITY OF WALLA WALLA, WASHINGTON.
Corps of Engineers, Walla Walla, Wash.
For primary bibliographic entry see Field 04A.
W69-06469

FLOOD PLAIN INFORMATION, YAKIMA RIVER, BENTON COUNTY, WASHINGTON.
Corps of Engineers, Seattle, Wash.
For primary bibliographic entry see Field 04A.
W69-06470

FLOOD PLAIN INFORMATION, OMAHA METROPOLITAN REGION, NEBRASKA - VOLUME 1.
Corps of Engineers, Omaha, Nebr.
For primary bibliographic entry see Field 04A.
W69-06471

FLOOD PLAIN INFORMATION, CEDAR RIVER, LINN COUNTY, IOWA.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W69-06472

FLOOD PLAIN INFORMATION, GUAYANILLA RIVER, GUAYANILLA, PUERTO RICO.
Corps of Engineers, Jacksonville, Fla.
For primary bibliographic entry see Field 04A.
W69-06473

GEOLOGY AND HYDROLOGY OF CLAY COUNTY SOUTH DAKOTA-PART 1, GEOLOGY, AND PART 2, WATER RESOURCES,
South Dakota Geological Survey, Vermillion; and Geological Survey, Vermillion, S. Dak.
For primary bibliographic entry see Field 02F.
W69-06486

A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
Aerospace Research Labs., Wright-Patterson AFB, Ohio.
H. Leon Harter.
Technometrics, Vol 11, No 1, pp 177-187, Feb 1969. 11 p, 1 tab, 14 ref.

Descriptors: *Flood forecasting, Flood hydrographs, *Flood peaks, Floodwater, Distribution, Hydrology, Probability, *Statistical methods, *Floods, Hydrologic data, Statistical analysis, Statistical models, Statistics.
Identifiers: *Pearson type III distrib, *Flood estimate, Skewness, Flood frequency, Flood hydrology, *Flood probability, Tables (Data).

The U S Water Resources Council recently proposed the standardization of peak flood discharge analysis by fitting a Pearson Type III distribution to the logarithms of the data. This action drew attention to the inadequacy of available tables of percentage points of such distribution. Tables of percentage points of the related chi-square distribution could be used to obtain percentage points of the Pearson Type III distribution, but a table giving these percentage points directly would be more convenient. A 5-decimal-place table and a description of the computation method are given. Possible applications are discussed, including estimating return periods of floods. (USBR)
W69-06680

STREAMFLOW RECORD LENGTH FOR MODELLING CATCHMENT DYNAMICS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
Walter M. Grayman, and Peter S. Eagleson.
Mass Inst of Technol Hydrodynamics Lab Rep No 114, Feb 1969. 137 p, 40 fig, 8 tab, 26 ref, 6 append. OWRR Grant No. 14-01-0001-1576.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, Synthetic hydrology, Linear programming, Digital computers, Climatology, Precipitation (Atmospheric), Computer programs, Runoff forecasting, Streamflow forecasting.
Identifiers: *Precipitation patterns, Catchment dynamics.

The length of rainfall-streamflow record required for the formulation of a linear model of catchment dynamics is investigated as a function of the physical characteristics of the catchment and of the climate. Climates with more homogeneous precipitation patterns require shorter lengths of rainfall-streamflow record. For the 2 climates tested, 5 years of record allows the hydrologist to be quite confident that his linear model is truly representative of the real world. The linear model is limited in accuracy by the degree of linearity of the real system. A parameter describing the relative dynamic importance of streamflow compared to overland flow appears to be a convenient measure of linearity. Extreme values indicate either catchment or stream control, and yield a smaller irremovable error than obtained with the median values which show equal catchment-stream influence. There is a general computational trend to the irremovable error. Analysis of this trend may be used to develop an improved, quasi-linear forecasting method. Computer program listings of the model and tabulated results of computations with it are included. (Knapp-USGS)
W69-06781

HEC-2, WATER SURFACE PROFILES.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W69-06787

HEC-3, RESERVIOR SYSTEM ANALYSIS.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W69-06788

GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
For primary bibliographic entry see Field 07B.
W69-06811

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
For primary bibliographic entry see Field 02F.
W69-06815

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
For primary bibliographic entry see Field 02F.
W69-06816

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
For primary bibliographic entry see Field 02F.
W69-06817

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
For primary bibliographic entry see Field 02F.
W69-06818

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
For primary bibliographic entry see Field 02F.
W69-06819

FLOOD PLAIN INFORMATION, BOISE RIVER AND NORTHSIDE TRIBUTARIES, BOISE, IDAHO AND VICINITY.
Corps of Engineers, Walla Walla, Wash.
For primary bibliographic entry see Field 04A.
W69-06823

FLOOD PLAIN INFORMATION OF SPRING VALLEY CREEK, SAN DIEGO COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W69-06824

FLOOD PLAIN INFORMATION OF SENECA LAKE, NEW YORK.
Corps of Engineers, Buffalo, N. Y.
For primary bibliographic entry see Field 04A.
W69-06825

FLOOD PLAIN INFORMATION, CAYUGA LAKE, NEW YORK.
Corps of Engineers, Buffalo, N. Y.
For primary bibliographic entry see Field 04A.
W69-06826

FLOOD PLAIN INFORMATION, CANANDAIGUA LAKE, NEW YORK.
Corps of Engineers, Buffalo, N. Y.
For primary bibliographic entry see Field 04A.
W69-06827

RAINFALL-RUNOFF RELATIONS FOR SOUTHEASTERN LOUISIANA AND SOUTHWESTERN MISSISSIPPI,
Geological Survey, Baton Rouge, La.
For primary bibliographic entry see Field 02A.
W69-06829

IMPROVED TECHNIQUES FOR ESTIMATING RUNOFF WITH BRIEF RECORDS,
New South Wales Univ., Manly (Australia). Water Research Lab.
F. C. Bell.
New South Wales Univ Water Res Lab Rep No 91, June 1966. 185 p, 45 fig, 7 tab, 189 ref, 1 append.

Descriptors: *Rainfall-runoff relationships, *Runoff forecasting, *Mathematical models, Rainfall, Runoff, Streamflow, Base flow, Infiltration, Retention, Water storage, Hydrogeology, Evapotransporation, Small watersheds, Hydrographs, Duration curves, Hydrograph analysis.
Identifiers: *Australia.

A selective literature survey and general analysis of runoff statistics are presented. From these it is concluded that single, brief records give inaccurate estimates of means and quite unreliable estimates of extremes. Improved estimates are possible if single records are supplemented with other relevant information and it is shown that spatial correlation or regional consistencies can be utilised for this purpose. The recently developed 'complete' rainfall-runoff models provide a means of extending or synthesizing records but some of the components of these models are inconsistent with current knowledge of the physical processes of hydrology. Other deficiencies in the models are caused by their attempts to integrate fragmentary hydrological concepts that have evolved without reference to the rainfall-runoff cycle as a whole. A more comprehensive approach is suggested by replacing the traditional 'infiltration theory' with a general 'retention theory' from which an improved rainfall-runoff model is developed. The improved model is demonstrated and tested with data from a 60 acre watershed. (Knapp-USGS)
W69-06830

SYSTEMS APPROACH FOR INTEGRATING GROUND WATER AND SURFACE WATER USE.
Aerojet-General Corp., El Monte, Calif. Environmental Systems Div.; and Engineering-Science, Inc., Arcadia, Calif.
For primary bibliographic entry see Field 06A.
W69-06834

DYNAMICS OF CHANNEL FLOW,
V. N. Goncharov.
Available from Clearinghouse as TT64-11003 at $3.00 in paper copy. Leningrad Gidrometeorologicheskoe Izdatel'stvo, 1962. 317 p, 55 fig, 15 tab, 16 ref.

Descriptors: *Open channel flow, *Channel flow, *Alluvial channels, *Sediment transport, *Erosion, Channel morphology, Regime, Sedimentation, Meanders, River training, Reservoirs, Flow, Civil engineering, Channel-flow dynamics.
Identifiers: *USSR, Textbook.

Open-channel flow is discussed in a comprehensive handbook intended to help solve practical problems in water resources development, hydroelectric projects, and navigation. Part 1 subdivides rigid-channel flow dynamics into plane-flow mechanism, boundary layers, tribulent flow, rectilinear flows in rectangular channels, rectilinear river flows, flow in channel bends, and flow resistance (obstacles). Part 2 discusses dynamics of deformable-bed flows, including parameters describing grandular channel-materials, sediment transport, sediment transport regimes, sediment transport effects, channel process dynamics, sedimentation in control-reservoir headraces, and channel-deformation conditions in tailraces. (Knapp-USGS)
W69-06835

2F. Groundwater

A SIMPLIFIED TECHNIQUE FOR WELL-FIELD DESIGN,
Dames and Moore, Los Angeles, Calif.
J. Russell Mount.
Ground Water, Vol 7, No 3, pp 5-8, May-June 1969. 4 p, 2 fig, 3 tab, 1 ref.

Descriptors: *Water resources development, *Groundwater, *Design criteria, *Analytical techniques, *Well spacing, Optimum development plans, Planning, Water management (Applied), Aquifers, Water costs, Water utilization, Water-level fluctuations.
Identifiers: *Well-field design.

The planned development of an individual water supply from a group of wells must take into consideration several factors, including aquifer coefficients of transmissibility and storage, aquifer boundaries, static water level, aquifer depth, recharge capabilities, competing users, the area available for well fields, locations of wells in fields, and pumping rates. Water requirements, water cost, and well-field life expectancy are related to limitations of acreage, drawdown of water level, and the investment in pumping and transmission facilities. Well-field design calculations involve the combined interference of waterlevel drawdown among the various wells in the field. Conventional calculation methods are usually time-consuming. Final design decision can be approached quickly if it is assumed that the wells have regular spacing. An example well-field problem is given, using a simple formula and table; the problem can be calculated in a few minutes with a slide rule. It is suggested that when well spacing deviates appreciably from the assumed spacing, the final design calculations be made with computer techniques. (Lang-USGS)
W69-06421

CONTROL OF SEA-WATER INTRUSION IN A GROUND-WATER AQUIFER,
Los Angeles County Flood Control District, Calif.
A. E. Bruington.
Ground Water, Vol 7, No 3, pp 9-14, May-June 1969. 6 p, 11 fig.

Descriptors: *Saline water intrusion, *Aquifers, *Ground water, *California, Recharge, Injection wells, Sea water, Groundwater barriers, Cost comparisons, Hydraulic gradient.
Identifiers: Los Angeles (Calif), Saline water intrusion control.

Sea-water intrusion into ground-water reservoirs occurs when permeable formations outcrop into a body of sea water and when there is a landward hydraulic gradient. Intrusion can be controlled by reducing pumping, by increasing supply, or by forming some type of barrier. Pressure barriers are operated in Los Angeles County, California. Special facilities are needed and costs of operation are high. One system is 7 1/2 miles long and injects 45,000 acre-feet per year through 83 injections wells. The other system is one mile long and injects 5000 acre-feet per year through 17 injection wells. There are 55 employees involved full time on operation and maintenance of the systems. The operation and maintenance cost for these two systems during fiscal year 1966-67 was $13 per acre-foot of water injected. The filtered Colorado River water used is now purchased at a price of $24 per acre-foot. The capital outlay costs for injection wells, distribution pipeline, observation wells and other similar equipment are about $10 per acre-foot. (Knapp-USGS)
W69-06422

CONCEPTUAL MODELS FOR CARBONATE AQUIFERS,
Pennsylvania State Univ., University Park.
William B. White.
Ground Water Vol 7, No 3, pp 15-21, May-June 1969. 7 p, 6 fig, 1 tab, 18 ref.

Descriptors: *Aquifers, *Karst, Limestones, Carbonate rocks, Groundwater movement, Recharge, Discharge (Water), Sinks, Subsurface drainage, Caves, Flow nets, Water table, Aquifer-stream relationships.
Identifiers: *Carbonate aquifers.

Groundwater behavior in carbonate terrains can be classified by relating the flow type to a particular hydrogeologic environment distinguished by characteristic cave morphology. The groundwater may move by diffuse flow, by retarded flow, or by free flow. Diffuse flow occurs in less soluble rocks such as extremely shaley limestones or crystalline dolomites. Integrated conduits are rare. Caves tend to be small, irregular, and often little more than solutionally widened joints. Retarded flows occur in artesian environments where unfavorable stratigraphy forces groundwater to be confined to relatively thin beds. Network cave patterns are characteristic; solution occurs along many available joints. Free flowing aquifers are those in which solution has developed a subsurface drainage system as an underground extension of surface streams. Characteristic cave patterns are integrated conduit systems often truncated into linear, angulate, and branchwork caves. Other geologic factors such as structure, detailed lithology, relief, and locations of major streams, control the details of cave morphology and orientation of the drainage network. (Knapp-USGS)
W69-06423

MICROBIAL PROBLEMS IN GROUNDWATER,
National Water Supply Research Lab., Washington, D. C.
For primary bibliographic entry see Field 05C.
W69-06426

INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02E.
W69-06427

A DESIGN METHOD FOR DEEP WELL DEWATERING INSTALLATIONS,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. Herbert.
Ground Water, Vol 7, No 2, pp 24-33, Mar-Apr 1969. 10 p, 13 fig, 9 ref, 1 append.

Descriptors: *Dewatering, *Drainage engineering, *Drainage wells, *Water wells, Discharge (Water), Pumping, Drawdown, Water-level fluctuations, Water levels, Unsteady flow, Saturated flow, Design.
Identifiers: *Dewatering system design, Deep wells.

A new method for deep well dewatering systems is given. The method analyzes 3 dimensional flow to multiwell systems by considering the 2 end points to the initial fast phase of water table fall. Optimum distributions of dewatering wells, radius of influence of individual wells and well arrays, water discharge, time-drawdown relations, and predicted water levels may be calculated. Calculated results were checked against an analog model and a case history and found to be in good agreement with both. (Knapp-USGS)
W69-06430

GROUND WATER, GRAVITY AND RIFT VALLEYS IN MALAWI,
Southern Illinois Univ., Carbondale. Dept. of Geology.
Richard W. Davis.
Ground Water, Vol 7, No 2, pp 34-37, Mar-Apr 1969. 4 p, 5 fig, 3 ref.

Descriptors: *Surveys, *Gravity studies, *Hydrogeology, Geohydrologic units, Aquifers, Groundwater basins, Saline water systems, Alluvium, Water sources, Water resources development, Faults (Geology), Irrigation.
Identifiers: *Africa, Rift Valley, Malawi.

A preliminary geohydrologic survey was carried out in the Lower Shire Valley, Malawi, Africa in the summer of 1967. The valley is part of the East African Rift System. In order to develop more adequate knowledge of subsurface conditions, a reconnaissance gravity survey was performed. The survey showed that potential aquifer material over much of the valley was too thin to support high yield irrigation wells. In addition when combined with hydrochemical data the survey disclosed a high probability of water contamination by brines circulating upward along fault systems. In a few areas, irrigation wells may be developed. These areas were more sharply defined. (Knapp-USGS)
W69-06431

WATER-RESOURCES APPRAISAL OF THE LOWER MOAPA-LAKE MEAD AREA, CLARK COUNTY, NEVADA,
Geological Survey, Carson City, Nev.
F. Eugene Rush.
Nevada State Div of Water Resources Reconnaissance Ser Rep 50, Dec 1968. 66 p, 3 fig, 1 plate, 20 tab, 46 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Nevada, Irrigation water, Hydrologic budget, Water yield, Water quality, Water utilization, Streamflow, Water levels, Groundwater basins, Water sources.
Identifiers: Lower Moapa-Lake Mead Area (Nev).

A hydrologic budget was calculated for the lower Moapa-Lake Mead area in arid southeastern Nevada. Except for Lake Mead the region has very limited water resources. The study area is drained by the Muddy River, which has an average annual inflow of about 33,000 acre-ft and an outflow of about 34,000 acre-ft. Groundwater occurs in carbonate bedrock and alluvial valley fill aquifers. The total potential annual water yield area is about 48,000 acre-ft of which 22,000 acre-ft was consumed for irrigation and rural domestic uses in 1967. The high salinity hazard of the water limits development of irrigation to the full perennial yield. (Knapp-USGS)
W69-06435

EFFECTS OF THE DROUGHT ON WATER RESOURCES-SURFACE AND SUBSURFACE HYDROLOGY,
Geological Survey, Arlington, Va.
For primary bibliographic entry see Field 02B.
W69-06440

SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
Geological Survey, Washington, D. C.
Glenn A. Clark, Harold Meisler, Edward C. Rhodehamel, and Harold E. Gill.
N J State Div of Water Policy and Supply, Water Resources Circ No 18, 1968. 53 p, 5 fig, 7 tab, 11 ref.

Descriptors: *Water resources, *Groundwater, *New Jersey, *Water yield, Water wells, Water quality, Aquifers, Hydrologic data, Water levels, Hydrogeology.
Identifiers: *Atlantic County (NJ), Public water supplies.

Atlantic County is located in southeastern New Jersey in the Coastal Plain physiographic province. The principal fresh-water aquifers are in the Kirkwood Formation of Miocene age and the Cohansey Sand of probable Miocene and Pliocene age. The Kirkwood Formation is tapped primarily by industrial and public-supply wells. Reported yields of such wells range from 250 to 1,200 gpm. The median yield is 700 gpm. Specific capacities of these wells range from 2.5 to 34 gpm per ft of drawdown and the median is 15 gpm per ft drawdown. The Cohansey Sand is tapped widely by wells for domestic and poultry-farm use as well as for industrial use, public supply, air conditioning, and irrigation. Reported yields of industrial, public-supply, and air-conditioning wells range from 30 to 1,400 gpm and the median yield is 720 gpm. Specific capacities of these wells range from 2.4 to 43 gpm per ft drawdown and the median is 22 gpm per ft drawdown. Water from both formations is generally low in dissolved solids and in total hardness. Water from some Cohansey wells along the coast is very high in dissolved solids, chlorides, and other constituents, indicating salt-water encroachment. Ten public water-supply systems in Atlantic County pumped an average of 16.2 mgd of groundwater in 1964. Because of a summer influx of tourists, water use is considerably higher during the summer months. In 1964, pumpage during July, the peak month, was more than twice that during February, the lowest month. (Knapp-USGS)
W69-06448

GEOLOGY AND GROUND-WATER RESOURCES OF BURLINGTON COUNTY, NEW JERSEY,
Geological Survey, Trenton, N. J.
Eugene F. Rush.
N J State Div of Water Policy and Supply, Spec Rep No 26, 1968. 65 p, 25 fig, 7 tab, 38 ref.

Descriptors: *Water resources, *Groundwater, *New Jersey, Water yield, Water sources, Aquifers, Water quality, Water wells, Water levels, Hydrologic data, Observation wells.
Identifiers: Burlington County (NJ).

Burlington County, New Jersey, which lies between Trenton, Atlantic City and Camden, has an area of 827 sq mi. The county is in the Atlantic Coastal Plain physiographic province, has moderate temperatures and a dependable rainfall of 44 inches per year. The area is attracting new industries and additional population. Water usage is increasing with this economic growth; 26 mgd of groundwater were used in 1960. The Raritan and Magothy Formations are the most prolific producers, but the Cohansey Sand and Kirkwood Formation have a great and, as yet, untapped potential. Small to moderately large supplies have been obtained from other aquifers. The maximum average potential recharge to the groundwater reservoirs is estimated to be about 790 mgd. Presently, most of it is rejected because the aquifers are essentially full. On this basis, it is believed that groundwater supplies in Burlington County are sufficient for the foreseeable future. However, well spacing must be planned to avoid local overdevelopment. (Knapp-USGS)
W69-06449

GEOLOGY AND GROUND-WATER RESOURCES OF THE RAHWAY AREA, NEW JERSEY,
Geological Survey, Trenton, N. J.
Henry R. Anderson.
N J State Div of Water Policy and Supply, Spec Rep No 27, 1968. 72 p, 10 fig, 6 tab, 54 ref.

Descriptors: *Water resources, *Groundwater, *New Jersey, *Water yield, Water quality, Aquifers, Sands, Shales, Water levels, Specific capacity, Water sources.
Identifiers: Rahway area (NJ).

Groundwater in the Rahway area in New Jersey is pumped from the Triassic Brunswick Shale, the Cretaceous Raritan Formation, and Pleistocene stratified glacial drift. The Brunswick Shale yields about 6 mgd from fracture openings and from permeable interbedded sandstones. The aquifer is recharged through the hydraulically continuous overlying glacial drift. The average yield of 150 industrial, public supply, and domestic wells is 75 gpm, the specific capacity is 2.2 gpm per ft, and average well depth is 218 ft. The water is locally high in sulfate, dissolved solids, and hardness. The Farrington Sand Member of the Raritan Formation yields about 1 mgd. The average yield of 12 industrial wells is 96 gpm, the specific capacity averages 9.5 gpm per ft, and average well depth is 60 ft. The stratified drift is 30 ft thick under Rahway and yields over 1 mgd from 4 wells tapping both the drift and the underlying shale. The average yield per well is 370 gpm, and the average specific capacity is 15.3 gpm per ft. (Knapp-USGS)
W69-06450

WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02E.
W69-06451

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, Washington, D. C.
J. D. Turner, J. C. Scott, J. G. Newton, H. G. Golden, and J. R. Avrett.
Geol Surv of Ala Basic Data Rep and Map No 76, 1968. 12 p, 6 fig, 1 map, 4 tab.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Alabama, Water wells, Streamflow, Water yield, Water quality, Water levels, Hydrologic data, Data collections, Aquifers, Hydrogeology.
Identifiers: Coffee County (Ala).

The water availability in Coffee County, Alabama is described by maps showing streamflow, areas of potential well yields of over 0.5 mgd from 1 major aquifer, depth to water, and thickness and depth of the major aquifer. A compilation of basic data includes well depths, aquifer tapped, water level, and construction data for 101 wells. Chemical analyses of well, stream, and spring waters are also compiled. In most of the county water supplies are adequate to meet any forecast demand and are of good enough quality for most uses. (Knapp-USGS)
W69-06452

GROUND WATER FAVORABILITY MAP OF THE OTTAUQUECHEE-SAXTONS RIVER BASIN, VERMONT,
Geological Survey, Montpelier, Vt.; and Vermont Dept. of Natural Resources.
Arthur L. Hodges, Jr., and David Butterfield.
Vermont Dep Water Resources Groundwater Favorability Map, 1968. 1 sheet, 1 map, 2 tab.

Descriptors: *Water resources, *Water yield, *Groundwater, *Vermont, Permeability, Alluvium, Glacial drift, Groundwater basins, Water wells, Water sources.
Identifiers: Connecticut River (Vt), Ottauquechee River, Saxtons River.

The potential for groundwater development in the Ottauquechee-Saxtons River basin, Vermont is shown by a groundwater favorability map. Groundwater favorability areas are determined by lithology. Areas underlain by thick coarse-grained stratified glacial drift should have excellent potential for municipal and industrial water supply. Areas underlain by thin coarse-grained drift yield low to moderate amounts of water for domestic, commercial, and light industrial use. Areas underlain by fine-grained drift and swamp deposits have low potential, suitable for domestic wells only. Unstratified drift and bedrock yield only enough water for domestic or light commercial uses. The areas of best groundwater potential are along the smaller rivers of the basin. The Connecticut River Valley contains too much silt and clay for good yields in most locations. (Knapp-USGS)
W69-06463

GROUND WATER FAVORABILITY MAP OF THE WEST-DEERFIELD RIVER BASIN, VERMONT,
Geological Survey, Montpelier, Vt.; and Vermont Dept. of Water Resources.
Arthur L. Hodges, Jr., and David Butterfield.
Vermont Dep Water Resources Groundwater Favorability Map, 1968. 1 sheet, text, 1 map, 2 tab.

Descriptors: *Water resources, *Water yield, *Groundwater, *Vermont, Permeability, Alluvium, Glacial drift, Groundwater basins, Water wells, Water sources.
Identifiers: Connecticut River (Vt), West River, Deerfield River, Groundwater availability.

The potential for groundwater development in the West and Deerfield Rivers drainage basin in southeastern Vermont is shown by a groundwater favorability map. Groundwater favorability areas are determined by lithology. Areas underlain by thick coarse-grained stratified glacial drift should have excellent potential for municipal and industrial water supply. Areas underlain by thin coarse-grained drift have low to moderate potential, suitable for domestic, commercial, and light industrial use. Areas underlain by fine-grained drift and swamp deposits have low potential, suitable for domestic wells only. Areas underlain by unstratified drift and bedrock will yield only enough water for domestic or light commercial use. The areas of best groundwater availability are along the Winhall River and the West River. The main stem of the Connecticut River has too much silt and clay for good yields. (Knapp-USGS)
W69-06464

GROUND WATER FAVORABILITY MAP OF THE WELLS-OMPOMPANOOSUC RIVER BASIN, VERMONT,
Geological Survey, Montpelier, Vt.; and Vermont Dept. of Water Resources.
Arthur L. Hodges, Jr., and David Butterfield.
Vermont Dep Water Resources Groundwater Favorability Map, 1968. 1 sheet, text, 1 map, 2 text.

Descriptors: *Water resources, *Water yield, *Groundwater, *Vermont, Permeability, Alluvium, Glacial drift, Groundwater basins, Water wells, Water sources.
Identifiers: Connecticut River (Vt), Ompompanoosuc River, Wells River.

The potential for groundwater development in the Wells-Ompompanoosuc River basin, Vermont, is shown by a groundwater favorability map. Groundwater favorability areas are determined by lithology. Areas underlain by thick coarse-grained stratified glacial drift should have excellent potential for municipal and industrial water supply. Areas underlain by thin coarse-grained drift yield low to moderate amounts of water for domestic, commercial, and light industrial use. Areas underlain by fine-grained drift and swamp deposits have low potential, suitable for domestic wells only. Unstratified drift and bedrock yield only enough water for domestic or light commercial use. The areas of best groundwater potential are along the river valleys. Some parts of the Connecticut Valley are filled by silt and clay deposits with low yields. (Knapp-USGS)
W69-06465

GROUND WATER FAVORABILITY MAP OF THE WHITE RIVER BASIN, VERMONT,
Geological Survey, Montpelier, Vt.; and Vermont Dept. of Water Resources.
Arthur L. Hodges, Jr., and David Butterfield.
Vermont Dep Water Resources Groundwater Favorability Map, 1968. 1 sheet, text, 1 map, 2 tab.

Descriptors: *Water resources, *Water yield, *Groundwater, *Vermont, Permeability, Alluvium, Glacial drift, Groundwater basins, Water wells, Water sources.
Identifiers: White River (Vt), Connecticut River.

The potential for groundwater development in the White River basin, Vermont is shown by a groundwater favorability map. Groundwater favorability areas are determined by lithology. Areas underlain by thick coarse-grained stratified glacial drift should have excellent potential for municipal and industrial water supply. Areas underlain by thin coarse-grained drift yield low to moderate amounts of water for domestic, commercial, and light industrial use. Areas underlain by fine-grained drift and swamp deposits have low potential, suitable for domestic wells only. Unstratified drift and bedrock yield only enough water for domestic or light commercial use. The areas of best groundwater potential are along valleys except in a few locations where silt and clay deposits have low yield. (Knapp-USGS)
W69-06466

A CONTRIBUTION TO THE STUDY OF GROUNDWATER INTAKE RECHARGE IN KARST,
Institute for Geological and Geophysical Research, Belgrade (Yugoslavia).
J. Vilimonovic.
Hydrol of fractured rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 482-488, 1967. 7 p, 3 fig, 2 tab.

Descriptors: *Infiltration, *Groundwater recharge, *Karst, *Hydrologic properties, Porosity, Permeability, Climate, Hydrogeology, Geophysics, Water storage, Water wells, Limestones, Drainage, Channel flow, Fissures (Geology), Water level fluctuations, Vegetation, Rainfall.
Identifiers: *Yugoslavia, Dinaric coastal area, Zadar area, Dalmatia.

Because groundwater recharges in karstic areas depend mainly on the absorption properties of the catchment areas and the degree of influence of atmospheric precipitation on the karstic groundwater regime, the coefficient of infiltration in relation to the hydrological properties was investigated by using the broader area of Zadar in Dalmatia, as an example. The geological, hydrogeological, and geophysical data recorded in the Zadar area show the presence of considerable reserves of fresh groundwater in the carbonate rocks of this catchment area. The study shows that the groundwater reserves in karstic areas depend on the infiltration properties of carbonate rocks, and that reliable evaluation of groundwater discharge at some particular point depends on proper evaluation of the infiltration coefficient. Some discussion on the effect of rainfall on the karstic groundwater regime is given. Variations of groundwater level are described and related to rainfall patterns. (Gabriel-USGS)
W69-06484

SOME DETAILS ON THE CIRCULATION OF GROUNDWATER IN NON-KARSTIFIED FISSURED FORMATIONS IN CZECHOSLOVAKIA (FRENCH),
K. Zima.
Hydrol of fractured rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 489-495, 1967. 7 p, 3 fig.

Descriptors: *Groundwater movement, *Water circulation, *Crystalline rocks, *Sedimentary rocks, *Basalts, Fissures (Geology), Springs, Faults, Aquifers, Water types, Permeability, Geochemistry, Structural geology, Artesian wells, Sandstones, Conglomerate rocks, Igneous rocks.
Identifiers: *Czechoslovakia, Southern Bohemia.

Groundwater circulation in fissured crystalline and sedimentary rocks of Czechoslovakia was investigated on the basis of geological, and hydrological data. The study shows that open faults found in the fissured formations drain the small systems of joints and fissures and may capture the water of areas of several hundred square kilometers. Where there is a tectonic contact with permeable horizons, the water from the fissures augments the supplies in the porous strata (so called secondary aquifers). This tectonic juxtaposition produces high yielding and often artesian aquifers. The primary origin of the springs in the area is sufficiently demonstrated by their low mineralization character (total dry residue, 100-150 mg/l) and relatively high radioactivity. Discharges from the springs range from a few liters per second to several hundred l/s. Several aquifers were discovered in igneous and sedimentary rocks as a result of the application of hydrogeological research in Czechoslovakia. (Gabriel-USGS)
W69-06485

GEOLOGY AND HYDROLOGY OF CLAY COUNTY SOUTH DAKOTA-PART 1, GEOLOGY, AND PART 2, WATER RESOURCES,
South Dakota Geological Survey, Vermillion; and Geological Survey, Vermillion, S. Dak.
Cleo M. Christensen, and Jerry C. Stephens.
S Dak State Geol Surv Bull No 19, 1967. Part 1, 86 p, 16 fig, 4 plate, 5 tab, 41 ref, 1 append. Part 2, 62 p, 11 fig, 4 plate, 5 tab, 35 ref.

Descriptors: *Water resources, *Groundwater, *South Dakota, Surface waters, Aquifers, Water quality, Water yield, Water sources, Water wells, Hydrogeology, Water levels, Permeability.
Identifiers: Clay County (S Dak).

Clay County, South Dakota obtains most of its water supplies from wells. Surface waters are little used because the discharge of the Vermillion River is supplied largely from runoff and is very erratic. Groundwater supplies over 70% of the County's water. The Lower Vermillion-Missouri aquifer is composed mainly of outwash, averages 100 ft thick, and underlies 75% of the county. Its permeability ranges from 1,000 to 2,500 gpd/sq ft. Water levels are 10-15 ft below the land surface under floodplains and 75-100 ft under uplands. The Dakota Sandstone underlies all of the county and contains water under artesian pressure. The piezometric surface ranges from 1,280 to 1,120 ft altitude. Most of the water available in the county is fresh or slightly saline, hard with calcium sulfate, and undesirable amounts of iron, manganese, sulfate, and total dissolved solids. All aquifers yield water good enough for stock and some domestic uses, and good to permissible for irrigation, with low sodium hazard and high salinity hazard. (Knapp-USGS)
W69-06486

ARTIFICIAL RECHARGE OF A FISSURED SANDSTONE AQUIFER, TANGIERS, MOROCCO (FRENCH),
For primary bibliographic entry see Field 04B.
W69-06487

ITERATIVE ANALYSIS: BOUNDED LEAKY ARTESIAN AQUIFER,
Manitoba Univ., Winnipeg. Dept. of Actuarial Mathematics and Statistics; and Research Council of Alberta, Edmonton. Groundwater Div.
S. A. Bukhari, A. Vanden Berg, and D. H. Lennox.
J Irrig and Drain Div, ASCE, Vol 95, No IR1, Proc Paper 6431, pp 1-14, March 1969. 4 fig, 4 tab, 7 ref.

Descriptors: *Confined water, *Aquifers, *Drawdown, *Leakage, *Boundaries (Surfaces), Groundwater, Wells, Hydraulics, Computers, Data collections, Analytical techniques, Transmissivity, Storage coefficient, Estimating, Numerical analysis, Bedrock, Equations, Digital computers.
Identifiers: *Iterative analysis, *Algorithms.

Application of the leaky artesian well function to analysis of aquifer test data may be difficult if there are boundaries close enough for their effects to obscure those of leakage. If available information is adequate to establish boundary locations with reasonable accuracy, and if transmissibility and storage coefficient can be determined from early draw-down data, leakage factor B may be determined by iterative adjustment of an initial rough estimate until observed and calculated drawdowns match within some specified range of accuracy. An algorithm for iterative adjustment was developed and a method of improving its efficiency discussed. Formulas were presented for generalized image-well positions for a strip aquifer and all results combined and applied to digital computer analysis of drawdown data for a buried preglacial bedrock-valley aquifer. (Affleck-Ariz)
W69-06508

ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
Bureau of Reclamation, Denver, Colo. Experimental Design Analysis Section; and Bureau of Reclamation, Denver, Colo. Water Utilization Branch.
H. Boyd Phillips, and Harris R. McDonald.
J Irrig and Drain Div, ASCE, Vol 95, No IR1, Proc Paper 6435, pp 27-42, March 1969. 11 fig, 9 ref.

Descriptors: *Analog models, *Groundwater mining, *Water supply, *Withdrawal, Model studies, Aquifers, New Mexico, Wells, Water table, Computer models, Water distribution (Applied), Recharge, Water storage, *Irrigation water.
Identifiers: *Portales Valley (New Mexico).

A study utilizing an electric resistor-capacitor analog model, has been made to determine the adequacy of the ground water supply for the approximate 60,000 acres now irrigated in Portales Valley, New Mexico. Results indicated that over 60% of the irrigated area will be without sufficient water by the year 2010 unless an additional supply is found. A proposed plan to import water from a well field outside the project area was investigated. The aquifer underlying the project area would be utilized as a distribution system. Although some small areas would become deficient, the supply of water from the well field would be sufficient to sustain irrigation in nearly all the area now under irrigation until at least the year 2010. (Affleck-Ariz)
W69-06509

A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
Ain Shams Univ., Cairo (Egypt). Dept. of Soils.
H. Hamdi, Salah Eldin Mitwally, and Bishay Guindi.
Geoderma, Vol 2, No 1, pp 27-32, Sept 1968. 1 fig, 3 tab, 3 ref.

Descriptors: *Hydraulic conductivity, *Alluvium, *Subsoil, *Sampling, *Measurement, Soil profiles, Soil texture, Permeability, Particle size, Aggregates, Cores, Core drilling, Boreholes, Clays, Water table.
Identifiers: *Auger holes, *United Arab Republic, Nile River Valley, Formulae.

Hydraulic conductivity determinations of subsoil strata were conducted using the auger hole method at 26 locations distributed throughout the Nile Valley and Delta. The different methods of calculating hydraulic conductivity values from the rate of water rise in the auger holes were Ernst nomographs, Ernst and Kirkham formulae, and Ernst formulae. Hydraulic conductivity values were also obtained from undisturbed soil cores for purposes of comparison. There was no significant difference between the three methods of calculating hydraulic conductivity. All hydraulic conductivity values measured by the auger method were higher than those of undisturbed soil core samples. The values confirmed suitability of auger hole values for designing depths and spacings of drains in the heavy, clayey and compact alluvial soils of Egypt. (Affleck-Ariz)
W69-06517

GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
Weizmann Inst. of Science, Rehovoth (Israel); Israel Atomic Energy Commission, Rehovoth; and Geological Survey of Israel, Jerusalem. Hydrogeological Div.
E. Mazor, E. Rosenthal, and J. Ekstein.
Journal of Hydrology, Vol 7, No 3, pp 246-275, Mar 1969. 30 p, 8 fig, 3 tab, 21 ref, 2 append.

Descriptors: *Geochemistry, *Chemical analysis, *Water chemistry, *Mineral water, *Hydrogeology, Sampling, Water quality, Dissolved solids, Aquifer characteristics, Water temperature, Wells, Springs, Thermal water, Fresh water, Saline water, Salts, Lake basins, Trace elements, Radioactivity.
Identifiers: *Israel, Dead Sea Basin.

Chemical composition of thermal and mineral waters along the southwestern shores of the Dead Sea was investigated. Data included 108 chemical analyses of different water samples, taken from 36 wells and springs. Chemical composition of the waters was used as a tracing tool for the determination of various groups of waters in the investigated area. Three distinct water groups were found in the area. The Kikar-Noit group waters had temperatures ranging up to 42 deg C and contained up to 17g/l dissolved solids. The Zohar-Yesha group waters had temperatures of 33 deg C to 39 deg C, 50-190g/l dissolved solids, and up to 40mg/l H sub 2 S. The third group consisted of fresh waters. This report deals with the geographical extension of the established water groups and the mutual relations between them. (Affleck-Ariz)
W69-06747

GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
Weizmann Inst. of Science, Rehovoth (Israel); Israel Atomic Energy Commission, Rehovoth; and Water Planning for Israel Ltd., Haifa.
Emanuel Mazor, and Felix Mero.
Journal of Hydrology, Vol 7, No 3, pp 276-317, Mar 1969. 42 p, 12 fig, 10 ref, 2 append.

Descriptors: *Water chemistry, *Mineral water, *Lake basins, *Fresh water, *Chemical analysis, Geochemistry, Water quality, Springs, Wells, Sampling, Data processing, Magnesium, Calcium, Ion exchange, Water properties.
Identifiers: *Israel, *Lake Tiberias Basin, Water associations.

Two hundred sixty analyses of different water samples from seventy wells and springs around the Lake Tiberias basin were studied. The data were processed by simple graphical methods in order to find out the general geochemical regularities and to define large water associations of uniform composition. Four compositional-geographical water subgroups were found. In spite of minor differences between these subgroups, all these waters belong to one compositional association known as the Tiberias-Noit water association. Composition and maximum concentrations of the water association were quite close to the oceanic values. The Tiberias basin waters were also compared with other mineral waters in the Rift Valley and waters all over the world. (Affleck-Ariz)
W69-06748

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
Weizmann Inst. of Science, Rehovoth (Israel); Israel Atomic Energy Commission, Rehovoth; and Water Planning for Israel Ltd., Haifa.
Emanuel Mazor, and Felix Mero.
Journal of Hydrology, Vol 7, No 3, pp 318-333, Mar 1969. 16 p, 2 fig, 1 tab, 15 ref.

Descriptors: *Connate water, *Mineral water, *Brines, *Infiltration, *Sea water, Geochemistry, Lake basins, Saline water, Springs, Wells, Water chemistry, Evaporation, Groundwater basins, Paleohydrology, Salts, Thermal water, Chemical analysis, Porous media, Rocks, Reservoirs.
Identifiers: *Lake Tiberias Basin, *Israel, Rift Valley, Water associations, Dead Sea, Tectonics.

The genesis of mineral waters of the Tiberias-Noit water association was discussed. This water association consists of 150 wells and springs around Lake Tiberias, tens of springs in the Beit Shean Valley and 22 sources on the shores of the Dead Sea. It was suggested that the ocean had a temporary connection to the Rift Valley in the past. Enormous amounts of sea water were trapped in separate reservoirs when the waters infiltrated porous rocks in various fissured and faulted blocks that were under tectonic tension. The permeated blocks were brought under compression by later

tectonic movements and the brines were squeezed out and pushed upwards. These brines were mixed in various degrees with local fresh waters. (Affleck-Ariz)
W69-06749

THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
Weizmann Inst of Science, Rehovoth (Israel). Dept. of Isotopes.
Joel R. Gat, E. Mazor, and Y. Tzur.
Journal of Hydrology, Vol 7, No 3, pp 334-352, Mar 1969. 18 p, 5 fig, 1 tab, 20 ref.

Descriptors: *Stable isotopes, *Mineral water, *Groundwater, *Brines, *Mixing, Evaporation, Lakes, Deuterium, Sampling, Wells, Saline water, Sea water.
Identifiers: *Jordon Rift Valley, Israel, Fossil groundwater, Dead sea, Lake Tiberias.

The stable isotopic composition (super 18 O and super 2 H) of mineral water sources in the Jordon Rift Valley were examined to determine the origin of their fluid component. It appeared that these sources evolved through a two stage mixing process. It was suggested that some time in the past waters of a slightly evaporated seawater lake mixed with the prevailing groundwaters, to form various fossil brine pockets along the Rift Valley's floor. Today these brines mix with local groundwaters and sometimes with the waters of Lake Tiberias and the Dead Sea. There was no evidence of changes in the isotopic content of the water by exchange with rocks or by other fractionating processes. (Affleck-Ariz)
W69-06750

THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
Fresno Ground-Water Recharge Field Station, Calif. Southwest Branch.
E. E. Haskell, Jr., and W. C. Bianchi.
Ground Water, Vol 5, No 4, pp 12-17, March 1968. 7 fig, 4 tab, 10 ref.

Descriptors: *Hydrogeology, *Perched water, *Water table, *Irrigation wells, *Impervious soils, Hydrologic aspects, Geologic investigations, Groundwater barriers, California, Permeability, Core drilling, Water quality, Logging (Recording), Electrical well logging, Irrigation effects, Head loss, Soil profiles, Particle size, Clays.
Identifiers: *San Joaquin Valley, California.

Shallow, fine-textured layers are impeding vertical flow of ground water in unconsolidated alluvial sediments of the San Joaquin Valley. The area is intensely irrigated with water from deep wells, and excess irrigation is believed to be the source of the perched water. The quality of water is poor. Drilling and cores showed a dense clay layer at about 100 ft depth, about 10 feet thick, with low permeability. It is continuous within the area and slopes west. If more land is irrigated with less efficient practices, the area will have a drainage problem, which this study may help to solve. (Affleck-Ariz)
W69-06758

GEOLOGY, DESIGN, AND CONSTRUCTION OF DEEP WELLS IN SEDIMENTARY FOUNDATIONS,
Eugene B. Waggoner, and Willard G. Owens.
Am Water Works Assoc Jour, Vol 59, No 3, pp 379-382, Feb 1968.

Descriptors: *Wells, *Groundwater basins, *Aquifer characteristics, *Water wells, *Design criteria, Groundwater mining, Drilling, Testing, Drill holes, Oil wells, Water yield, Legal aspects, Economic feasibility, Geologic formations, Water quality, Pumping, Water pollution control, Hydrologic properties, Geophysics.

A study of general geologic and ground water conditions within an area should be made to justify ground-water development, using available records of test holes, seismic shot holes, oil wells, gas wells, or completed water wells, and actual results from development of nearby aquifers. Legal and economic aspects should be considered also; then test-hole drilling apparent hydrologic properties of the aquifers, thickness and estimated yields, stability of formations and required open area for transmission of water. Unexpected conditions might require modification of well design; zones of development remove drilling muds and cuttings, and fines, and provide for prevention of pollution. (Affleck-Ariz)
W69-06759

EFFECT OF SUBSIDENCE ON WELL FIELDS,
Santa Clara Valley Water Conservation District, San Jose, Calif.
For primary bibliographic entry see Field 04B.
W69-06763

A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
Research Council of Alberta, Edmonton.
For primary bibliographic entry see Field 07C.
W69-06764

THE GROUNDWATER PROVINCES OF IRAN,
Hebrew Univ., Jerusalem (Israel); Geological Survey of Israel, Jerusalem; and Center for Groundwater Research, Jerusalem (Israel).
For primary bibliographic entry see Field 04B.
W69-06772

TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 07B.
W69-06774

A RIGID PLATE MODEL OF THE BAROMETRIC EFFECT,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
J. A. Gilliland.
J Hydrol, Vol 7, No 3, pp 233-245, Mar 1969. 13 p, 6 fig, 7 ref.

Descriptors: *Barometric efficiency, *Water wells, Aquifers, Compressibility, Mathematical models, Elasticity (Mechanical), Water levels, Water table, Potentiometric level.
Identifiers: Jacobs equation, Rigid plate model.

The proposed 'rigid plate model' envisages a plate lying between the atmosphere and the water table which prevents the complete transfer of increased pressure loads to the groundwater mass. The barometric efficiency of a well is dependent not only on the properties of the aquifer, but also on the properties of the rigid plate. Jacob's equation is a special case of the general model. The soil moisture zone is one possible rigid plate. Measurements of barometric efficiency, air temperature and precipitation at Delta, Manitoba confirm the validity of the model. In the model it is assumed that response to pressure occurs instantaneously, the modulus of compressibility of the aquifer structure is substantially less than that of the aquifer grains, and that the discontinuities between the rigid layer and the capillary fringe as well as between the upper impermeable layer and the water level in the confining bed are negligible in effect. (Knapp-USGS)
W69-06775

CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Irrigation Engineering; and Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 03F.
W69-06796

THE USE OF ELECTRIC ANALOG MODELS IN HYDRODYNAMICAL STUDY OF THE ALSACE AQUIFERS (FRENCH),
Institut de Physique du Globe, Strasbourg (France).
P. Ungemach.
Grad Thesis, Strasburg Inst of Earth Phys, Mar 1968. 91 p, 14 fig, 11 plate, 95 ref.

Descriptors: *Aquifers, *Model studies, *Dynamics, Hydrologic properties, Hydrogeology, Geophysics, Mathematical studies, Permeability, Darcys law, Transmissivity, Porosity, Pumping, Water circulation, Viscosity, Velocity, Alluvium, Dupuit-Forchheimer theory, Flow, Pressure, River basins.
Identifiers: *Alsace (France), Electric analog model, Rhine River.

This investigation represents a mathematical analysis of pertinent parameters characterizing the hydrologic conditions usually found in large scale aquifers and a detailed study of similarity which exists between these developed analytical expressions and electrical current flows used as electric analog models. The analytical study is based on the use of Bernoulli's theorem, Darcy's law, continuity equation, and the Dupuit-Forchheimer hypothesis. Results of the electric analog models were applied to the hydrogeological data of the Rhine River alluvial aquifer recorded in 1966. The analysis shows that use of electrical analog models is a considerable contribution as a method for evaluation of aquifers. (Gabriel-USGS)
W69-06806

RANDOM PROCESSES AND LITHOLOGIC TRANSITIONS,
Indiana Univ., Bloomington. Dept. of Geology; and Indiana Geological Survey, Bloomington.
For primary bibliographic entry see Field 02J.
W69-06807

GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
For primary bibliographic entry see Field 07B.
W69-06811

ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
California Univ., Los Angeles. Dept. of Engineering.
John A. Dracup, and Yacov Y. Haimes.
Calif Univ Water Resources Center Rep, 1968. 7 p, 14 ref.

Descriptors: *Mathematical models, *Systems analysis, *Optimization, Linear programming, Simulation analysis, Digital computers, Input-output analysis, Synthetic hydrology, Dynamic programming.
Identifiers: *Multilevel optimization.

Groundwater aquifers can be analyzed as lumped or as distributed systems. In the lumped models the aquifer parameters of the system are considered as aggregated for the entire basin. In the distributed models the aquifer parameters are distributed into nodes throughout the basin. Lumped models have been analyzed using optimization techniques, however, simulation analysis has mainly been used for distributed models. It is proposed that distributed models of groundwater systems can be analyzed using multilevel optimization techniques. The concept of multilevel optimization technique is based on the decomposition of large scale and composed

systems followed by the reconstruction of the system into independent subsystems. The multilevel and the multigoals of the procedure are then defined. This procedure is accomplished by introducing new variables, called psuedo variables, into the system. Each subsystem is then separately and independently optimized. This is called a first level optimization. The subsystems are tied together into a 2nd level optimization through coordinator parameters (such as Lagrangian Multipliers), which are responsible for the optimization of the whole system. The characteristics of groundwater basins may be determined by organizing producing water wells into a multilevel structure. Such determinations can greatly aid water resource planning agents who are attempting to coordinate surface water and groundwater resources in an optimal manner. (Knapp-USGS)
W69-06813

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
Victor M. Shamburger, Jr., J. C. Scott, H. G. Golden, and J. R. Avrett.
Ala State Geol Surv Maps 72 and 73, 1968. Map 72, text 1 sheet, 9 ref; map 73, text, 5 fig, 5 tab, 7 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Alabama, Water wells, Streamflow, Water yield, Water quality, Water levels, Hydrologic data, Data collections, Aquifers, Hydrogeology.
Identifiers: Pike County (Ala).

The water availability and geology of Pike County, Alabama are described by maps showing geology, streamflow, areas of potential well yields of over 1 mgd from 2 major aquifers, depth to water, and thickness and depth of the major aquifers. A compilation of basic data includes well depth, aquifer tapped, water level, and construction data for 200 wells. Chemical analyses of well, stream, and spring waters are also compiled. In most of the county water supplies are adequate to meet any forecast demand and are of good enough quality for most uses. (Knapp-USGS)
W69-06815

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
J. G. Newton, J. F. McCain, and J. R. Avrett.
Ala State Geol Surv Maps 70 and 71, 1968. Map 70, 1 sheet, 1 fig, 10 ref, map 71, text, 2 fig, 4 tab, 6 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Alabama, Water wells, Streamflow, Water yield, Water quality, Water levels, Hydrologic data, Data collections, Aquifers, Hydrogeology.
Identifiers: Henry County (Ala).

The water availability and geology of Henry County, Alabama are described by maps showing geology, streamflow, areas of potential well yields of over 1-2 mgd from 2 major aquifers, depth to water, and thickness and depth of the major aquifers. A compilation of basic data includes well depth, aquifer tapped, water level, and construction data for 103 wells. Chemical analyses of well, stream, and spring waters are also compiled. In most of the county water supplies are adequate to meet any forecast demand and are of good enough quality for most uses. (Knapp-USGS)
W69-06816

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
R. D. McWilliams, J. C. Scott, H. G. Golden, J. G. Newton, and J. R. Avrett.
Ala State Geol Surv Maps 68 and 69, 1968. Map 68, 1 sheet, 7 ref, map 69, text, 4 fig, 6 tab.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Alabama, Water wells, Streamflow, Water yield, Water quality, Water levels, Hydrologic data, Data collections, Aquifers, Hydrogeology.
Identifiers: Crenshaw County (Ala).

The water availability and geology of Crenshaw County, Alabama are described by maps showing geology, streamflow, areas of potential well yields of over 1-3 mgd from the 3 major aquifers, depth to water, and thickness and depth of the major aquifers. A compilation of basic data includes well depth, aquifer tapped, water level, and construction data for 98 wells. Chemical analyses of well, stream, and spring waters are also compiled. In most of the County water supplies are adequate to meet any forecast demand and are of good enough quality for most uses. (Knapp-USGS)
W69-06817

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
J. G. Newton, H. G. Golden, J. R. Avrett, and J. C. Scott.
Ala State Geol Surv Maps 63 and 64, 1968. Map 63, 1 sheet, text, 2 fig, 6 ref; map 64, text, 2 fig, 7 tab.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Alabama, Water wells, Streamflow, Water yield, Water quality, Water levels, Hydrologic data, Data collections, Aquifers, Hydrogeology.
Identifiers: Dale County (Ala).

The water availability and geology of Dale County, Alabama are described by maps showing geology, streamflow, areas of potential well yields of 2 mgd or greater depth to water, and thickness of the major aquifers. A compilation of basic data includes well depth, aquifer tapped, water level, and construction data for 169 drilled wells. Chemical analyses of well, stream, and spring waters are also compiled. In most of the county water supplies are adequate to meet any forecast demand and of good enough quality for most uses. (Knapp-USGS)
W69-06818

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
Alabama Geological Survey, University; and Geological Survey, University, Ala.
J. D. Turner, J. C. Scott, J. F. McCain, and J. R. Avrett.
Ala State Geol Surv Maps 66 and 67, 1968. Map 66, 1 sheet, 6 ref; map 67, text, 2 fig, 4 tab.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Alabama, Water wells, Streamflow, Water yield, Water quality, Water levels, Hydrologic data, Data collections, Aquifers, Hydrogeology.
Identifiers: Covington County (Ala).

The water availability and geology of Covington County, Alabama are described by maps showing geology, streamflow, areas of potential well yields of over 0.5 mgd from the 3 major aquifers, depth to water, and thickness and depth of the major aquifers. A compilation of basic data includes well depth, aquifer tapped, water level, and construction data for 93 drilled wells. Chemical analyses of well, stream, and spring waters are also compiled. In most of the County water supplies are adequate to meet any forecast demand and are of good enough quality for most uses. (Knapp-USGS)
W69-06819

RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
Geological Survey, Washington, D. C.
William Thordarson, R. A. Young, and I. J. Winograd.
Geol Surv -At Energy Comm Open-file rep TEI-872, Dec 1967. 26 p, 2 fig, 1 tab, 18 ref.

Descriptors: *Data collections, *Wells, *Boreholes, *Nevada, Logging (Recording), Borehole geophysics, Water yield, Water quality, Water supply, Hydraulics, Hydrogeology, Geohydrologic units, Aquifers, Water temperature.
Identifiers: *Test holes, Well data, Cuttings logs, Pumping tests, Aquifer testing.

Hydrogeologic and construction data obtained from 119 test holes, wells, and emplacement holes at the Nevada Test Site and vicinity (through December 1966) are tabulated. The availability of cuttings, cores, lithologic logs, geophysical logs, formation-water analyses, hydraulic test data, and detailed construction data for each hole, as well as references to published reports for selected holes, are noted. (Knapp-USGS)
W69-06820

GROUNDWATER IN FRACTURED VOLCANIC ROCKS IN SOUTHERN ARIZONA,
Geological Survey, Arlington, Va.
L. A. Heindl.
Hydrol of fractured rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 503-513, 1967. 11 p, 3 fig, 9 ref.

Descriptors: *Groundwater, *Igneous rocks, *Fissures (Geology), *Arizona, Alluvium, Permeability, Groundwater movement, Groundwater barriers, Water supply, Water yield, Hydrologic properties, Geologic investigations, Tertiary period, Basins, Transmissivity, Groundwater recharge.
Identifiers: Southern Arizona, Volcanic rocks.

This article summarizes the general conditions under which water occurs in fractured volcanic rocks in southern Arizona and suggests certain guidelines for further investigation of the potential productivity of these rocks on the basis of geological, hydrological, and topographical data given in earlier publications. The study shows that locally wells in andesitic flows yield as much as 60 liters/s; the yields are highly variable and cannot be reliably predicted even within short distances. Yields from volcanic rocks are obtained from interflow breccias and primary voids and fractures. Fractured volcanic rocks in the basin-and-range country of southern Arizona also underlie areas of recharge in the mountains and act as conduits in transmitting water to reservoirs in the alluvium or in the permeable volcanic rocks buried by or interbedded with the alluvium. Some criteria for the projection of water-bearing fractures to below the surface are suggested. (Gabriel-USGS)
W69-06831

SYSTEMS APPROACH FOR INTEGRATING GROUND WATER AND SURFACE WATER USE.
Aerojet-General Corp., El Monte, Calif. Environmental Systems Div.; and Engineering-Science, Inc., Arcadia, Calif.
For primary bibliographic entry see Field 06A.
W69-06834

2G. Water in Soils

THEORY OF SOIL MOISTURE - VOL 1, MOISTURE PROPERTIES OF SOILS AND MOVEMENT OF SOIL MOISTURE,
Akademiya Nauk SSSR, Moscow. Pochvennyi Institut.
A. A. Rode.
Order from the Clearinghouse as TT-68-50441. Papercopy $3.00; Microfiche $0.65. Transl from Gidrometeorologicheskoe Izdatel'stvo, Leningrad, 1965. 560 p, 188 fig, 122 tab, 630 ref.

Descriptors: *Soil moisture, *Soil water movement, Soilewater-plant relationships, Soil science, Soil physics, Soil chemistry, Soil properties, Soil investigations, Soil water, Unsaturated flow, Diffusion, Evapotranspiration, Infiltration, Lysimeters, Moisture tension.
Identifiers: *USSR, Book.

Soil moisure, soil moisture movement, and soil properties are described in a comprehensive monograph of the present state of soil moisture science in the USSR. The approach to soil hydrologic studies in the USSR involves experiments and observations under field conditions, in which the soil layer is studied as a whole in its native state. The discussion of the water properties of soils is subdivided into porosity, water properties, sorption of water vapor, sorption of liquid water, suspended water, and free gravitational water. The discussion of soil water movement and soil-water-plant relationships is subdivided into thermodynamics, water motion, soil moisture and plants, and forms of soil moisture. The approaches to soil moisture studies in the US, Europe, and the USSR are described and compared. (Knapp-USGS)
W69-06489

DISPLACEMENT FRONT UNDER PONDED LEACHING,
California Univ., El Centro. El Centro Field Station.
James N. Luthin, Pedro Fernandez, Boris Masloc, Jack Woerner, and Frank Robinson.
J Irrig and Drain Div, ASCE, Vol 95, No IR1, Proc Paper 6446, pp 117-125, March 1969. 4 fig, 7 ref.

Descriptors: *Leaching, *Saline soils, *Drains, *Ponding, *Salts, Drainage, Irrigation water, Dispersion, Soil chemistry, Soil surfaces, Equations, Theoretical analysis, Analytical techniques.
Identifiers: *Displacement, Kirkham's equation.

Leaching of tile-drained soils by ponding water on the soil surface was examined both experimentally and theoretically. A method of analyzing movement of the displacement front was presented. The method was based on piston-type displacement of saline soil water by the added leaching water. In this initial analysis presence of precipitated salts, hydrostatic dispersion, and soil-chemical reactions were ignored. Experimental results obtained on a 15 by 6 by 3 foot tank showed satisfactory agreement to theoretical results obtained by solving Kirkham's equation for the ponded water case. Results indicated that ponded leaching was inefficient in removing salts midway between drains. Intermittant leaching by applying excessive amounts of irrigation water should be more efficient in controlling soil salinity. (Affleck-Ariz)
W69-06510

DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
Agricultural Research Service, Washington, D. C. Soil and Water Research Div.; and South Dakota State Univ., Brookings. Remote Sensing Inst.
R. R. Allen, and V. I. Myers.
Trans ASAE, Vol 12, No 1, pp 29-31, Jan 1969. 6 fig, 5 ref.

Descriptors: *Aquifers, *Drainage systems, *Drains, *Tiles, *Subsurface drainage, Permeability, Sands, Texas, Electrical resistance, Electrical conductance, Analog models, Model studies, Water table, Flow measurement, On-site data collections, Effluents, Soil water movements.

This paper reports a field and electrical resistance analog study of subsurface tile drainage of an area near Raymondville, Texas, where the top of the sand aquifer was 10 ft. below ground surface. A subsurface tile drain, placed 8 ft. deep, yielded considerable effluent yet had a limited effect on the water table. Field and electrical analog data indicated that the underlying aquifer supplied 70 to 75% of the total tile flow. It was suggested that successful water-table control might be achieved through subsurface drains planned as an area unit rather than isolated individual systems. Such a system would be costly and involved. Single 8 ft drains appeared to be the most feasible for individual field areas. (Affleck-Ariz)
W69-06512

EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
Clemson Univ., S. C.
James T. Ligon.
Trans ASAE, Vol 12, No 1, pp 121-126, 129, Jan 1969. 7 fig, 2 tab, 16 ref.

Descriptors: *Soil moisture, *Soil moisture meters, *Measurement, *Gamma rays, *Evapotranspiration, Instrumentation, Variability, Soil temperature, Air temperature, Sampling, Moisture content, Soil profiles, Interfaces, Equations, On-site date collections, Soil density, Field capacity.

This study reports on use of the gamma transmission system in a practical field situation. The theory, some of the problems encountered, techniques employed, and results obtained were presented in this paper. Some of the conclusions were that unexplained variations in count rates which occurred in the field were probably due to sensitivity of the detector system to temperature differences between air and soil and between different soil levels. The system was capable of measuring moisture changes with 1/2 inch of the soil surface and near interfaces within the soil profile. Major soil moisture changes owing to infiltration, drainage, or evapotranspiration over a period of several days could be detected and the distribution pattern of the accretion of depletion observed. The system at present does not appear to be sufficiently sensitive to accurately detect small moisture changes spread over a large part of the profile, such as evapotranspiration for a 24 hour period. (Affleck-Ariz)
W69-06514

FIELD OBSERVATIONS OF SOME PHYSICAL PROPERTIES IN ALLUVIAL SOILS OF ARID AND SEMI-ARID REGIONS,
Food and Agriculture Organization of the United Nations, Rome (Italy).
S. A. Radwanski.
Soil Science, Vol 106, No 4, pp 314-316, October 1968. 6 ref.

Descriptors: *Soil physical properties, *Surface sealing, *Salts, *Soil surfaces, *Surface waters, Arid climates, Semiarid climates, Rain water, Alluvium, Soil water movement, Irrigation water, Drainage effects, Winds, Cultivation, Soil profiles, Runoff, Silts, Penetration, Velocity, Flow, Evaporation.
Identifiers: *Microlamination, Lamination.

Physical properties of soils in arid and semi-arid regions were discussed with respect to microlamination and self-sealing, distorted drainage, salts and wind effect. Microlamination was often produced when silt or other soil particles were desposited from water flowing with a variable velocity. Thin laminae interfered with conventional movement of water in the soil profile. This sealing was virtually watertight and it may happen that most seasonal rainwater does not penetrate the soil but stands on the surface or runs off. In the intense desert heat surface water evaporates, salts precipitate and a cumulative effect over a number of seasons produced a salt deposit resting on the soil surface. Self-sealing caused by wind-affected surface layers was generally less serious from the agricultural point of view than that caused by microlamination. Tillage could be used to break the seal caused by microlamination and self-sealing resulting from a salt deposit on the soil surface and wind affecting surface layers of arid soils. (Blecker-Ariz)
W69-06515

TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
Michigan State Univ., East Lansing.
George J. Bouyoucos, and Ray L. Cook.
Soil Science, Vol 106, No 4, pp 317-322, October 1968. 3 fig, 2 tab, 14 ref.

Descriptors: *Hygrometry, *Moisture content, *Wilting point, *Moisture tension, *Soil water, Wheat, Plant physiology, Osmotic pressure, Electrical resistance, Root systems, Absorption, Atmosphere, Humidity, Loam, Measurement, Moisture uptake.
Identifiers: *Gray hydrocal hygrometer, Non-saline soils.

The gray hydrocal hygrometer was used to measure soil moisture tensions or matrix suctions of non-saline soils when soils were at or near the permanent wilting point. Results revealed that magnitude of the tension of soil water when ultimate wilting occurred varied from 23.4 - 25.0 atmospheres. Osmotic pressure of unwilted vigorous growing young plants was 0.5 atmospheres as compared to 57.1 and 64.9 atmospheres of wilted plants. Osmotic pressure of roots in the wilted plants was 25.4 and 26.0 atmospheres. Data showed that when wheat plants reached the ultimate wilting point in non-saline soils, soil moisture tension was about 24.0 atmospheres. The root system was the main factor in determining true tension of soil water when ultimate wilting occurred. Soil moisture tensions are important in arid soils where plants can be under a moisture stress for long periods of time. (Blecker-Ariz)
W69-06516

THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
Department of Agriculture, Ottawa (Ontario). Plant Research Inst.
W. Baier, and George W. Robertson.
Agricultural Meteorology, Vol 5, pp 17-31, 1968. 1 fig, 32 ref, 6 tab.

Descriptors: *Soil moisture, *Climatic data, *Regression analysis, *Crop production, *Estimating, Rainfall, Temperature, Correlation analysis, Field capacity, Meteorological data, Model studies, Moisture content, Plant growth, Wheat, Environmental effects.
Identifiers: *Soil moisture budget, *Canada.

This study attempts to appraise the value of soil moisture estimates made with soil moisture budget using only standard climatic data as compared with direct use of climatological data in regression analysis for explaining variations in crop yields. Wheat yields from 39 plantings across Canada during five seasons were more closely related to estimated soil moisture than observations of rainfall, maximum and minimum temperatures. The versatile soil moisture budget has the advantage that soil moisture from different soil zones with diverse fertility levels can be weighted according to their contribution to yield. Results of the study demonstrate that significant crop-weather relations can be obtained if the meteorological factors are expressed in terms of environmental factors on which crops are directly dependent. (Blecker-Ariz)
W69-06519

PRINCIPLES OF CHOOSING EXPERIMENTAL PLOTS FOR WATER BALANCE STUDIES IN IRRIGATION REGIONS OF THE ARID ZONE,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
D. M. Katz.
Bulletin of the International Association of Scientific Hydrology, Col 10, No 4, pp 42-47, December 1965. 4 tab, 4 ref.

Descriptors: *Regional analysis, *Hydrologic data, *Hydrogeology, *Water balance, *Groundwater,

Climatic data, Arid climates, Mapping, Salt balance, Salts, Irrigation water, Terraces (Geological), On-site investigations, Drainage water, Inflow, Discharge (Outflow).
Identifiers: Experimental plots.

In the complex of regional water balance investigations, which must be carried out in major hydrogeological regions of arid climates, studies at experimental plots are of great importance and should meet objectives as outlined in this article. In order that results of studies in key plots be representative of the territory under investigation, choosing of plots should be based on analysis of detailed hydrogeological maps. On alluvial terraces studies at experimental plots must show peculiarities of the water-salt balance of terraces of different age which are usually distinguished in various degrees of natural drainage. The study of water balance and unconfined ground water balance on plots can be done by experimental observations and by using hydrodynamic analysis of the unconfined ground water regime. (Blecker-Ariz)
W69-06523

SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
V. P. Subrahmanyam, and A. R. Subramaniam.
Bulletin of the International Assoc of Scientific Hydrology, Vol 10, No 3, pp 31-37, September 1965. 5 fig, 8 ref.

Descriptors: *Climatic zones, *Subhumid climates, *Arid climate, *Semiarid climate, *Droughts, Dry seasons, Wet seasons, Climatology, Frequency, Moisture deficit, Moisture availability, Rainfall disposition, Hydrologic budget, Fluctuation, Stations.
Identifiers: *India, Aridity index.

De-cribed here were results of a climatic study of characteristics and decennial frequencies of droughts in three dry climatic zones of India. The zones were arid, semi-arid and dry subhumid. Climates were classified according to the water balance scheme of Thornthwaite. The aridity index was computed for each year of a 65-year period of record for all selected stations. From yearly trends of the index, it could be ascertained whether a station was becoming drier, less dry or remaining steady. The standard deviation was adopted for classification of droughts into four different degrees of severity: moderate, large, severe and disasterous. During the early part of this century North India experienced serious droughts while in South India mentionable droughts occurred in the latter decades. One aspect of drought climatology was occurance of climatic shifts resulting from wide year-to year fluctuations in water balance. Under such circumstances, it was not uncommon for the normal climatic regime to be thrown into one of more arid or more humid category. (Blecker-Ariz)
W69-06524

SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD,
Agricultural Research Service, Riverside, Calif. Salinity Lab.
E. J. Doering.
Soil Science, Vol 99, No 5, pp 322-326, May 1965. 2 fig, 1 tab, 10 ref.

Descriptors: *Soil water, *Soil texture, *Diffusivity, *Capillary conductivity, *Moisture content, Discharge (Water), Soil properties, Flow measurement, Fluctuation, Equilibrium, Sampling.
Identifiers: *One-step method, Equilibration, Fluxes, Gradients.

The one-step method was applied to a group of five soils of different textures in order to test its reliability for determining diffusivity and capillary conductivity of soils. The method produced reasonable diffusivity values and smooth functional relationships between diffusivity, capillary conductivity and water content. General agreement between diffusivity values obtained by the outflow methods and those obtained independently by the constant flux method supports the conclusion that the values are reasonably accurate. Tests have also shown that the method is practical for determining diffusivity because only one equilibration is required for a given range of water content instead of the several equilibrations required by other methods. The one-step method measures soil properties that describe the flow of water in arid soils. (Blecker-Ariz)
W69-06528

DROUGHT AND SOIL MOISTURE,
Hydrometeorological Service of the USSR (Moscow).
M. S. Kulik.
Agricultural Meteorology, Vol 2, No 2, pp 79-83, April 1965. 2 tab, 6 ref.

Descriptors: *Cultivation, *Soil moisture, *Droughts, *Moisture availability, *Crop production, Moisture deficit, Soil-water-plant relationships, Air temperature, Precipitation (Atmosphere), Plant growth, Winds, Drought resistance, Field capacity, Wheat, Water requirements.
Identifiers: *U.S.S.R.

A considerable proportion of cultivated areas in the Soviet Union is concentrated in zones supplied only inadequately and irregularly with moisture. Analysis of data indicated that plants subjected to the same amount of precipitation may or may not undergo growth depression using high temperatures and dry winds. Methods and procedures are given on how effective moisture may be accumulated and retained in the soil so as to reduce the effect of a drought. Effectiveness of measures to increase soil moisture varies according to district, weather and combination of agronomic techniques applied. Introduction of modern drought-resistant varieties, high levels of cultural measures and curtailment of unproductive water expenditure by wasteful evaporation and drainage, can significantly reduce harmful effects of drought conditions on crop yields in arid climates. (Blecker-Ariz)
W69-06529

SOILS STUDIES USING COLOR PHOTOS,
McGill Univ., Montreal (Quebec).
For primary bibliographic entry see Field 07B.
W69-06696

EXTENDED TECHNIQUES OF CALCULATION OF SOIL-WATER MOVEMENT, WITH SOME PHYSICAL CONSEQUENCES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia).
J. R. Philip.
9th Int Congr Soil Sci, Trans, Vol 1, pp 1-9, Adelaide, Australia, 1968. 9 p, 1 fig, 1 tab, 20 ref.

Descriptors: *Soil water movement, *Soil water, *Soil moisture, Subsurface flow, Subsurface runoff, Infiltration, Unsaturated flow, *Analytical techniques, Porous media, Heterogeneity, Bibliographies, Homogeneity, Two-dimensional, Three-dimensional, Surface irrigation, Absorption, Moisture content, Wetting, Irrigation.
Identifiers: Analytical method, Quasi techniques, *Porous media flow, *Infiltraton rate, Wetting front.

Recently developed quasi-analytical and analytical methods are discussed for solving the nonlinear Fokker-Planck equation describing water movement in unsaturated soils and porous media. Techniques described are (1) the extension of existing quasi-analytical methods to 2- and 3-dimensional transient systems, (2) an analytically based method of analyzing 2- and 3-dimensional steady systems, (3) an analytically based method of establishing the envelope of possible integral behavior of 1-, 2-, and 3-dimensional transient systems, and (4) the extension of various quasi-analytical methods to a subclass of heterogeneous systems. Techniques (1), (2), and (3) lead to several important physical conclusions concerning the interaction of capillarity, gravity, and geometry in the absorption and infiltration processes. Special attention is given to large-time behavior: the finiteness, or otherwise, of the ultimately wetted region; the completeness, or otherwise, of the wetting process; and the existence, or otherwise, of a final steady state. The results have important consequences in connection with techniques of surface irrigation and of measuring final infiltration rates in the field. (USBR)
W69-06714

GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
For primary bibliographic entry see Field 07B.
W69-06811

2H. Lakes

THE AGING OF LAKES,
Wisconsin Univ., Madison. Water Chemistry Lab.
G. Fred Lee, and E. Gus Fruh.
Ind Water Eng, Vol 3, No 2, pp 26-30, Feb 1966. 2 fig, 12 ref.

Descriptors: *Eutrophication, *Lakes, Algae, Aquatic weeds, Cyanophyta, Fishkill, Fertilization, Limiting factors, Nitrogen compounds, Nutrients, Odor, Oligotrophy, Oxygen, Oxygen demand, Phosphorus compounds, Plant growth, Primary productivity, Rivers, Taste, Thermal stratification, Waste treatment, Water quality, Water pollution control, Water pollution effects, Water pollution sources.
Identifiers: *Cultural eutrophication, Recreational use, Waste effluents.

A lake's fertilization is determined to a large extent by the rate of nutrient influx. This situation is analogous to soils; more fertilizer, more crops. When lakes have excessive algae and/or rooted aquatic vegetation along the shoreline, it is a sign that this fertilization process is in motion. Frequently, the influence of man in the lake's watershed results in increased rates of nutrient influx which bring about an accelerated rate of standing crop production in the lake. This results in a deterioration of the water quality. Domestic and industrial water treatment costs are increased because of added cost to remove resultant taste and odors and increased numbers of organics from the eutrophic water. Such recreational pursuits as boating, fishing, and swimming can also be seriously impaired. Odor arising from decaying mats of algae can also seriously decrease the economic value of shoreline property. The large productivity of eutrophic lakes can lead to the absence of dissolved oxygen in certain parts of the hypolimnion, eliminating such cold-water sport fishes as trout and cisco. Thus, the cultural eutrophication of natural waters has become one of the major water management problems of today. (Lee-Wis)
W69-06535

SIMULATION OF AN AQUATIC ECOSYSTEM,
Washington State Univ., Pullman. Dept. of Zoology; and Washington State Univ., Pullman. Dept. of Information Science.
Richard A. Parker.
Biometrics, Vol 24, No 4, pp 803-822, Dec 1968. 9 fig, 3 tab, 18 ref.

Descriptors: *Systems analysis, *Ecosystems, *Simulation analysis, Water pollution effects, Lakes, Phosphorus, Trophic level, Productivity, Model studies, Salmon, Aquatic environment, Phosphates, Algae, Daphnia, Growth rates, Predation.
Identifiers: Kootenay Lake, British Columbia, Canada, Aquatic ecosystem model, Simulation model, Phosphorus effect, Cladecera.

A deterministic model simulating aquatic ecosystem of Kootenay Lake, British Columbia, was developed considering only conditions in upper 10 meters of south arm, which receives high phosphate load from tributary river. Solar radiation was expressed as weekly photoperiod changes; seasonal temperature curve derived from means of measurements at three depths. Four differential equations simulating change rates in phosphorus concentration, algae abundance, cladoceran density, and kokanee salmon biomass were simultaneously applied. Several appropriate constants were used. Change in phosphate concentration was assumed to be linear function of phosphate input to south arm, output from arm, and change rates in algal and cladoceran populations. Changes in biological components were derived essentially from difference between growth and death rates, which were assumed to be linearly dependent on combination of factors such as photoperiod, phosphate level, temperature, and predation. Model simulated algal and cladoceran cycles reasonably well but not phosphate cycle. 80% phosphate level reduction delayed algal peak 9 weeks and decreased other components more. 30% algal growth rate reduction delayed algal and cladoceran peaks by 1-2 weeks and decreased kokanee abundance. 30% algal death rate decrease produced no significant changes. Increasing cladoceran's algal predatory rates hardly displaced various peaks but depressed all populations. (Teraguchi-Wis)
W69-06536

ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
New York State Dept. of Health, Albany. Div. of Laboratories and Research.
For primary bibliographic entry see Field 05B.
W69-06541

SPECIES DIVERSITY AND COMMUNITY STRUCTURE IN LACUSTRINE PHYTOPLANKTON,
Wisconsin Univ., Madison. Dept. of Zoology.
Paul Edwin Sager.
PhD Thesis, Univ Wis, 1967. 201 p, 24 fig, 4 tab, 107 ref, 3 append. Available from University Microfilms, Ann Arbor, Mich. Cite their identification number 67-6827.

Descriptors: *Lakes, *Phytoplankton, Biomass, Ecology, Ecosystems, Eutrophication, Limnology, Oligotrophy, Wisconsin.
Identifiers: *Community structure, *Information theory, *Species diversity, Diversity indices, Gardner Pond B (Wis), Lake Mendota (Wis), Madison (Wis), Shannon's index of diversity, Trout Lake (Wis), Univ Wis Arboretum.

Author utilizes equations from information theory to estimate uncertainty or diversity of phytoplanktonic communities from Lake Mendota (Madison, Wisconsin), Trout Lake (northern Wisconsin), and Gardner Pond B (University of Wisconsin Arboretum). Of two components measurable by index of diversity, relative abundance and floristic richness, the former seems more important in characterizing these lacustrine communities. Floristic richness was less important because species in excess of the ten most abundant--having low density--had less significance for the index. Detailed treatment in this report includes, by chapter: discussion of the community concept, community structure, and the problem and its analysis; description of methodology; temporal aspects of three phytoplanktonic communities; structural characteristics of the communities; and a generalized discussion of the significance of the studies. Three appendices document an extensive data bank for the three communities including: volumetric estimates for species encountered (Mendota--79 species, Trout--87 species, and Gardner Pond--68 species); summary of seasonal abundance by numbers-density and volume-density; and summary of structural aspects, tabulating parameters of Shannon's diversity index. (Eichhorn-Wis)
W69-06542

WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1966-SEPTEMBER 1967,
Geological Survey, Austin, Tex.
Helen J. Davidson.
Geol Surv Open-file Rep No 115, Dec 1968. 34 p, 2 fig, 7 tab, 3 ref.

Descriptors: *Water quality, Small watersheds, *Reservoirs, *Texas, *Data collections, Salinity, Surface waters, Gaging stations, Density stratification.
Identifiers: Periodic observations, Hubbard Creek Reservoir (Tex).

Water quality data are compiled for the Hubbard Creek Watershed, Texas. A Network of daily chemical-quality and streamflow stations has been operated since 1962. In addition to daily data, several low-flow partial-record stations were observed periodically. In April 1964 a multiple-cell conductivity recorder was installed at the outlet of Hubbard Creek Reservoir. The cells are positioned at 2 ft from the bottom 30 ft from the bottom, and at the lake surface. The reservoir was sampled to study salinity stratification. (Knapp-USGS)
W69-06786

2I. Water in Plants

EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
Southwestern Great Plains Research Center, Bushland, Tex.
For primary bibliographic entry see Field 03F.
W69-06511

A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
North Carolina Agricultural Experiment Station, Raleigh.
Jerry R. Lambert, and Jan Van Schilfgaarde.
Soil Science, Vol 100, No 1, pp 1-9, July 1965. 9 fig, 15 ref.

Descriptors: *Soil-water-plant relationships, *Moisture content, *Instrumentation, *Measurement, *Leaves, Soil moisture, Stomata, Transpiration, Moisture stress, Plant physiology, Equations, Calibrations, Equilibrium, Thermocline, Drying, Energy budget.
Identifiers: *Water potential, *Intact plants, Equilibration, Gradients.

This investigation's objective was to develop a method of measuring water potential of leaves remaining intact on a plant. The term water potential was used to describe energy status of moisture in any part of a soil-plant-atmosphere system. Rapid change in probe output following either watering or initiation of accelerated drying substantiated the fact that system response was sufficiently fast to indicate dynamic changes reasonably well. In order to separate response lag of the plant to changes in soil moisture potential from measuring system lab, a considerably shorter equilibration period was desirable. The possibility was suggested of using the technique to study gradients and resistances in plants by simultaneous determination of water transpiration rates. The method described could be used to determine moisture stresses of plants placed in different arid environments. (Blecker-Ariz)
W69-06527

WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
Ministry of Agriculture, Wad Medani (Sudan). Research Div.
For primary bibliographic entry see Field 03F.
W69-06756

THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Agricultural Meteorology.
For primary bibliographic entry see Field 03F.
W69-06757

2J. Erosion and Sedimentation

A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
Colorado State Univ., Fort Collins.
S. A. Schumm.
Trans ASAE, Vol 12, No 1, pp 60-68, Jan 1969. 21 fig, 3 tab, 34 ref.

Descriptors: *Geomorphology, *Land forming, *Erosion control, *Semiarid climates, *Deposition (Sediments), Erosion, Drainage systems, Sediment transport, Sediment yield, Channels, Hydrologic aspects, Hydrologic data, Slopes, Gully erosion, Soil conservation, Runoff, Watershed (Basins).

A review of roughly ten years of research concerning semiarid land forms was given in this paper. An attempt was made to view erosional and depositional phenomena from a geomorphic perspective. The paper's objective was to suggest how geomorphic research into rates and mechanics of erosion processes and into interrelations that exist among geomorphic and hydrologic characteristics of drainage systems may assist both hydrologists and engineers in their practical goals of control and prediction. Emphasis on processes of landscape modification and a quantitative description of landforms has provided information on origin of certain features, and a means of delineating critical areas of the landscape where conservation techniques should be most effective. (Affleck-Ariz)
W69-06513

GRADED FURROWS FOR WATER EROSION CONTROL,
Blacklands Experiment Watershed, Riesel, Tex.; and Texas A and M Univ., College Station. Big Spring Field Station.
C. W. Richardson, R. W. Baird, and D. W. Fryrear.
J Soil and Water Cons, Vol 24, No 2, pp 60-63, Mar-Apr 1969. 5 fig, 2 tab, 4 ref.

Descriptors: *Furrow systems, *Erosion control, *Grading, *Runoff, *Slopes, Terracing, Irrigation efficiency, Texas, Crop production, Demonstration watersheds, Cultivated lands, Peak discharge.

At the Blackland Research Center, Temple, Texas, and the Blacklands Experimental Watershed, Riesel, Texas, research is underway to evaluate the effectiveness of a system of graded furrows as an erosion control measure. A system of furrows with a 1 percent grade successfully controlled erosion on areas with slopes up to 3 percent. Operating farm equipment on the furrow ridges was not appreciably more difficult than on flat-tilled areas, and crop yields were comparable to yields obtained on nearby conventionally-tilled areas. Runoff and soil-loss data from graded furrows up to 930 feet long indicated that both unit runoff and soil loss increased as furrow length increased. Graded furrows appeared to be a method of increasing the efficiency of field operations while protecting the soil from erosion. (Afflect-Ariz)
W69-06746

PREDICTION OF RAINSPLASH EROSION IN THE SEASONALLY WET TROPICS,
Australian National Univ., Canberra. Research School of Pacific Studies.
M. A. J. Williams.
Nature, Vol 222, No 5195, pp 763-765, May 24, 1969. 3 p, 4 fig, 41 ref.

Descriptors: *Raindrops, *Impact (Rainfall), *Erosion, *Tropical regions, Sheet erosion, Soil Surfaces, Sediment yield, Runoff, Rainfall-runoff relationships.

Identifiers: *Australia, Raindrop-impact erosion.

Raindrop-splash erosion was measured in a seasonally wet tropical area of northern Australia and methods of predicting raindrop erosion were established. Total cumulative rainfall momentum was found to be significantly related to cumulative weekly soil loss. Rain of a given momentum caused about 20 times less erosion late in the wet season than at the start when soil moisture was deficient. Both the proportion of runoff and the absolute amount increased during the wet season, so that soil erosion by runoff increased through the season. (Knapp-USGS)
W69-06768

DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 05B.
W69-06785

COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
Duke Univ., Durham, N. C.
For primary bibliographic entry see Field 02L.
W69-06798

LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
Birmingham Univ. (England). Dept. of Geology.
N. Hamilton, W. H. Owens, and A. I. Rees.
J of Geol, Vol 76, No 4, pp 465-472, July 1968. 8 p, 6 fig, 1 tab, 2 ref.

Descriptors: *Sediments, *Distribution patterns, *Model studies, Petrofabrics, Shear stress, Flumes, Dunes, Deltas, Flow around objects, Sands.
Identifiers: *Sand grain orientation, *Shearing sand.

Five experiments are described in which a bed of sand was subjected to shear and the resulting grain orientation estimated from measurements of anisotropy of magnetic susceptibility. Two experiments involved dry sand on angle-of-repose slopes, two involved the immersion of the inclined bed in still water, and in one the bed formed the foresets of a delta produced in a horizontal flume. It was found that the longest and shortest axes of the sand grains were always preferentially aligned in the plane perpendicular to the strike, longest axes being at a small 25-37 deg angle to the surface of accumulation. High magnetic q-values were characteristic of all the deposits. The results are consistent with theoretical prediction. (Lang-USGS)
W69-06799

RANDOM PROCESSES AND LITHOLOGIC TRANSITIONS,
Indiana Univ., Bloomington. Dept. of Geology; and Indiana Geological Survey, Bloomington.
Paul E. Potter, and Robert F. Blakely.
J of Geol, Vol 76, No 2, pp 154-170, Mar 1968. 17 p, 9 fig, 4 tab, 41 ref.

Descriptors: *Aquifers, *Stratigraphy, *Statistical methods, *Markov processes, Geologic formations, Hydrogeology, Synthetic hydrology, Sedimentation, Sedimentary petrology.
Identifiers: Synthetic stratigraphy, Statistical straitigraphy.

Bedding sequences and stratigraphic sections can be profitably considered from the standpoint of their lithologic transitions, that is, the probability of any particular unit being followed by the other units in the sedimentation system. Dependent Markov processes appear to be most appropriate for the study of lithologic transitions. This paper contains an elementary expository account of Markov processes and their relation to sedimentation. A Devonian limestone-dolomite-anhydrite sequence, an Ordovician limestone-shale sequence, and Pennsylvanian cyclothems show statistical evidence of at least a one-step dependence, or memory. Other geologic evidence also points to the existence of dependent lithologic transitions, especially in transgressive sequences. Markov processes can also be used to synthesize stratigraphic sections. (Knapp-USGS)
W69-06807

TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A CARBONATE BEACH, BIMINI, BWI,
Land-Sea Interaction Lab., Norfolk, Va.
For primary bibliographic entry see Field 02L.
W69-06809

A CLASSIFICATION OF PALEOCURRENT MODELS,
Imperial Coll. of Science and Technology, London (England). Dept. of Geology.
Richard C. Selley.
J of Geol, Vol 76, no 1, pp 99-110, Jan 1968. 11 p, 7 fig, 65 ref.

Descriptors: *Sedimentology, *Sedimentation, *Shores, Mathematical models, Sedimentary petrology, Sediment transport, Paleohydrology, Paleoclimatology, Sands, Sediments.
Identifiers: Paleocurrents.

A series of models is proposed to clarify the relationships between a number of regional paleocurrent patterns occurring repeatedly in time and space. Each model is defined by three parameters: environment (i.e., depositional process), azimuthal paleocurrent pattern at outcrop (i.e., unimodal, bimodal, or polymodal), and the relationship between paleocurrent pattern at outcrop (i. e., unimodal, bimodal, or polymodal), and the relationship between paleocurrents and paleoslope. One fanglomerate model is proposed, 2 fluviatile, 1 eolian, 6 shore-line, and 2 turbidite models. Fanglomerates are characterized by unimodal downslope-directed radiating paleocurrents. Both fluviatile models have unimodal downslope paleocurrents. In one case these are arranged radially, in the second, centripetally. Eolian paleocurrents may be unimodal, bimodal, or polymodal, and are unrelated to paleslope. One eolian model is definable by relating wind direction to high-pressure air cells. Shore lines are characterized by bimodal paleocurrents attributable to tidal currents, though unimodal and polymodal patterns are also known. These are all unrelated to paleoslope. Six shore-line models are proposed based on the presence or absence of fluviatile currents and on whether marine currents are dominantly onshore, offshore, or alongshore. The 2 turbidite models both have unimodal paleocurrents. These may be arranged in small-scale downslope radiating fans. On a larger scale, lateral and axial infilling is common in many marine troughs, though the role of turbidity currents has been questioned. All the models proposed are illustrated by reference to examples from ancient and recent sediments. The problems of deducing current directions from sedimentary structures are discussed. (Knapp-USGS)
W69-06810

DYNAMICS OF CHANNEL FLOW,
For primary bibliographic entry see Field 02E.
W69-06835

2K. Chemical Processes

POTASSIUM, ILLITE AND THE OCEAN,
Georgia Inst. of Tech., Atlanta.
Charles E. Weaver.
Water Resources Center, Ga. Tech., WRC-0169, Reprint from Geochimica et Cosmochimica Acta, Vol 31, 1967, pp 2181-2196, 1969. 16 p, 3 fig, 54 ref. OWRR Project A-008-GA.

Descriptors: *Potassium, *Illite, *Montmorillonite, *Clay minerals, *Geochemistry, *Oceans, Adsorption, Cations, Cation adsorption, Ion-exchange, Sodium, Hydrogen ion concentration, Connate water, Calsium, Water chemistry, Saline water, Marine geology.

The effects that ocean waters have on clays and the effects the clays have on the ocean are investigated. Some consider the extraction of potassium by the formation of illite to be one of the more important processes operative in the sea. Assumptions on which this idea is based are critically evaluated. Clay minerals are presently adsorbing from the ocean more Na+ than K+. Younger sediments have relatively more Na+ and montmorillonite and less K and illite than older sediments. This change, which occurred near the end of the Paleozoic era and appears to be world wide, is believed due to an increase in the Na, and perhaps Mg, content of the oceans, caused by the rapid development of plant life and an increase in soil acidity. Primitive biota may have aided in concentrating K in the early terrestial environment. Less than 10% of the K+ carried to the ocean today is in solution. This value may have been even smaller in the past. Considerably less K, in solution, has been cycled through the ocean than has been assumed. (Conway-Georgia Tech)
W69-06506

THE WORK OF THE FRESHWATER BIOLOGICAL ASSOCIATION OF GREAT BRITAIN IN REGARD TO WATER SUPPLIES. (a) THE NITROGEN BALANCE OF LARGE QUANTITIES OF WATER,
C. H. Mortimer.
Brit Waterworks Assoc, Official Circ, Vol 21, pp 853-866, 1939. 2 fig, 3 tab, disc.

Descriptors: *Nitrogen cycle, *Nitrogen, Nitrogen fixation, Nitrates, Nutrients, Ammonia, Inflow, Outflow, Lakes, Productivity, Eutrophication, Cycling nutrients.
Identifiers: Lake Windermere, England, Inflow waters, Outflow waters.

Author reviews the nitrogen cycle in soils and a lake system. The average nitrogen content of inflow and outflow waters of various English lakes in the summer of 1938 was determined. There was less total nitrogen in the outflow than in the inflow water of the productive lake types. This amount is probably in excess of the amount stored in the mud and represents nitrogen loss. In the less productive lake types there is either an approximate balance or there is a higher concentration of total nitrogen in the outflow. It is hypothesized that as a certain production level in a lake has been reached sources of nitrogen loss appear which gradually balance and eventually exceed nitrogen fixation. (Bortleson-Wis)
W69-06538

GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
Weizmann Inst. of Science, Rehovoth (Israel); Israel Atomic Energy Commission, Rehovoth; and Geological Survey of Israel, Jerusalem. Hydrogeological Div.
For primary bibliographic entry see Field 02F.
W69-06747

GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
Weizmann Inst. of Science, Rehovoth (Israel); Israel Atomic Energy Commission, Rehovoth; and Water Planning for Israel Ltd., Haifa.
For primary bibliographic entry see Field 02F.
W69-06748

THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
Weizmann Inst of Science, Rehovoth (Israel). Dept. of Isotopes.
For primary bibliographic entry see Field 02F.
W69-06750

WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1966-SEPTEMBER 1967,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02H.
W69-06786

RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
Aerojet-General Corp., El Monte, Calif.
For primary bibliographic entry see Field 03A.
W69-06837

RECOVERY OF SALTS FROM SALINE WATER VIA SOLVENT EXTRACTION (FINAL REPORT),
Dow Chemical Co., Walnut Creek, Calif.
For primary bibliographic entry see Field 03A.
W69-06839

2L. Estuaries

REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
Fish and Wildlife Service, Washington D. C.; and Bureau of Commercial Fisheries, Washington, D. C.
For primary bibliographic entry see Field 09C.
W69-06767

PROGRESS REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY, BEAUFORT, N. C., FISCAL YEAR 1968,
Bureau of Commercial Fisheries, Beaufort, N. C. Radiobiological Lab.
For primary bibliographic entry see Field 09C.
W69-06769

PRELIMINARY REMOTE SENSING OF THE DELAWARE ESTUARY,
Geological Survey, Philadelphia, Pa.
Richard W. Paulson.
Nat Aeron and Space Admin Tech Lett 128, Oct 1968. 22 p, 9 fig, 12 ref. NASA Contract No R-146-09-020-011. Task 160-75-01-63-10.

Descriptors: *Remote sensing, *Infrared radiation, *Photography, Surveys, Reaeration, Diffusion, Dispersion, Path of pullutants, Thermal pollution, Currents (Water), Water temperature, Waves (Water).
Identifiers: *Delaware Estuary, Infrared imagery.

Potential applications of remote sensing techniques for estuarine hydrology are discussed in a review of infrared imagery and aerial photography of the Delaware estuary. It is clear that infrared imagery can be an important estuarine reconnaissance tool. In addition, the analysis indicates that estuarine circulation, reaeration, and dispersion might be effectively studied with remote sensors. (USGS)
W69-06793

CHESAPEAKE BAY CASE STUDY.
Trident Engineering Associates, Inc., Annapolis, Md.
For primary bibliographic entry see Field 06B.
W69-06794

COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
Duke Univ., Durham, N. C.
Donald J. Swift.
J of Geol, Vol 76, No 4, pp 444-456, July 1968. 13 p, 12 fig, 2 plate, 43 ref.

Descriptors: *Sedimentation, *Erosion, *Stratification, *Stratigraphy, *Beaches, Barriers, Aquifers, Anisotropy, Aquicludes, Permeability, Hydrogeology, Sedimentology, Sands, Silts, Shores.
Identifiers: *Beach stratigraphy, Uncomformities, Ravinements.

Unconformities of transgressive sequences commonly occur within the basal beds of the sequences, not below them. Such unconformities, called ravinements, separate basal marsh, lagoon, estuarine, and beach deposits from overlying marine sands. Study of the ravinements in the Bay of Fundy shows that they are cut mainly by surf action along a narrow zone at the foot of the shore face. Spits in the Bay of Fundy advance shoreward before the ravinement, leaving no trace of their passage, except where the supply of shingle is so great that the spits are stabilized. Sea level shifts then result in the abandonment of an old barrier and the formation of a new. The Cretaceous Peedee and the Black Creek Formations of the Carolina Coastal Plain are separated by a well-developed ravinement when operating over a considerable period of time. Sporadic lenses of littoral sand at the Black Creek-Peedee interface indicate that the shoreline advanced in the stepwise manner characteristic of many transgressive shorelines. It is suggested that the ravinement process may contribute to stepwise migration. Shore face erosion may feed a barrier until the shore face is mantled in its own lag; the barrier is then overstepped and a new shoreline is formed. It has recently been shown that erosion by inlet migration is an important coastal process. If the barriers are retreating landward, an especially severe form of ravinement results. (Knapp-USGS)
W69-06798

TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A CARBONATE BEACH, BIMINI, BWI,
Land-Sea Interaction Lab., Norfolk, Va.
John D. Boon, III
J of Geol, Vol 76, no 1, pp 71-87, Jan 1968. 17 p, 16 fig, 3 tab, 16 ref.

Descriptors: *Beach erosion, *Sedimentation, *Beaches, *Sands, Tracers, Tracking techniques, Statistical methods, Bed load, Waves (Water), Currents (Water), Stochastic processes, Littoral drift, Surf.
Identifiers: *Trend surface analysis, *Bimini (BWI).

Two-dimensional trend surface analyses were performed on areally distributed tracer-concentration data for 3 different fluorescent sand tracers recovered from 4 depth, intervals of the foreshore of Bimini, BWI. The tracers had been affected by the swash, breakers, and logshore currents of 1 tidal cycle. Analysis of the statistical significance of trend surfaces for each depth interval showed that only the upper 2.5 cm of the sand column evidenced definite trend components. Differential sorting of tracers of different shapes and mean grain sizes was probably negligible, as deduced from the similarity in direction of orthogonals to the trend surface contours for the various tracer data. The advantage of the trend surface method of describing sand movement patterns on beaches lies in its ability to represent, in an objective manner, the average movement of sand grains by means of a single representative equation. Furthermore, for time scales of the order of minutes to several hours, the motion of sand is seldom parallel to the shore line. Studies attempting to define over-all particle drift at such time scales will be more meaningful where areal concentration data are objectively analyzed, as opposed to the subjective analysis of linear concentration data from samples collected parallel to the shore line. (Knapp-USGS)
W69-06809

A CLASSIFICATION OF PALEOCURRENT MODELS,
Imperial Coll. of Science and Technology, London (England). Dept. of Geology.
For primary bibliographic entry see Field 02J.
W69-06810

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

THE ROLE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IN THE DEVELOPMENT, USE AND CONTROL OF WATER RESOURCES.
International Atomic Energy Agency, Vienna (Austria).

Int Conf on Water for Peace, Wash, D C, Vol 5, pp 51-61, 1968. 11 p. For the 8 Volume Proc, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *Water resources development, *Nuclear energy, *United Nations, Organizations, Governments, Nuclear powerplants, Desalination, Tracers, Irrigation.
Identifiers: *International Atomic Energy Agency.

IAEA's Statute authorizes it 'to encourage and assist research on, and development and practical application of, atomic energy for peaceful uses throughout the world'. The IAEA has international responsibility for the application of nuclear techniques for water resources. At present IAEA's principal interests in water resources are: applying isotope techniques to hydrological problems; using nuclear energy for water desalination; establishing international safety standards to control radioactive pollution of water; technical assistance to its Member States in these fields. Isotope techniques include measurements of discharge of rivers; sediment measurements; snow hydrology and glaciology; groundwater movement; measurement of soil moisture; seepage from reservoirs and canals; geochronology; and the study of isotopic composition of water bodies to identify possible areas of recharge. A joint project with WMO measures concentrations of tritium, carbon-14, deuterium, and oxygen-18 in water. Desalination of water by the application of nuclear energy promises to meet a part of the municipal, industrial, and eventually, irrigation requirements for fresh water. In the future, nuclear energy is also likely to be involved in interbasin transfer of water and in the construction of civil works for water projects. Investigations are being made as to the practicability of a dual-purpose desalination plant for arid regions. The IAEA has specific responsibility for setting international standards of safety for any radioactive contamination of the environment that may originate from the peaceful uses of atomic energy, and studies radiation effects in oceanography. (Knapp-USGS)
W69-06456

OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
Stanford Univ., Calif.; and Mobil Oil Co., Paulboro, N. J.
J. H. Beamer, D. J. Wilde, B. A. Williams, and M. Arriel.
Proc, Nat Symp Anal Water-Resource Syst, pp 19-36, July 1968. 18 p, 5 fig, 5 ref.

Descriptors: *Desalination plants, *Optimization, *Flash distillation, *Design, Linear programming, Simulation analysis, Cost analysis, Economic efficiency, Mathematical models, Distillation, Water supply, Water treatment.
Identifiers: Los Angeles, Single effect, Multistage flash desalination.

The process of developing a model for a single effect multistage flash desalination plant, similar to the one planned for Los Angeles, was described to illustrate simulation techniques and considerations. Both an accurate nonlinear and an approximate linear model were constructed. The optimization of the models was described. The linearized approximation to the original model was constructed for computation speed and so that sufficient conditions could be determined at the optimum. The objective of the model was minimization of construction and operating costs subject to required capacity constraints. Some theoretical problems arising from the model application were discussed. (Gysi-Cornell)
W69-06495

ECONOMIC EFFECTS OF MINERAL CONTENT IN MUNICIPAL WATER SUPPLIES.
Black and Veatch, Kansas City, Mo.

Research and Development Report No 260, Office of Saline Water, U S Dept of Interior, 9 fig, 13 tab, append. May 1967. 159 p. OSW-14-01-001-537.

Descriptors: *Water properties, *Costs, *Corrosion, *Durability, Water quality, Mineralogy, Chemical properties, Capital costs, Operating costs, Annual costs, Investment, Economics, Damages, Water resource development, Water supply.
Identifiers: Mineralized water.

The purpose of this report is to evaluate the economic effect of mineral content of water supplies upon the facilities of water and sewage utilities and upon the customer. The adverse effects of mineralized waters result principally from corrosion, encrustation and related problems of both the water utility and customer facilities. The economic effects of using a water supply of a particular mineral content as compared to an alternate content could have a marked effect upon the economics of selection of the source to be developed. Emphasis has been placed on estimating the cost effects resulting from those minerals not readily and economically removed or neutralized in conventional water treatment processes. (Winn-Rutgers)
W69-06555

A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS: PART 1,
Brigham Young Univ., Provo, Utah; and Dow Chemical Co., Midland, Mich.
For primary bibliographic entry see Field 03C.
W69-06556

THE POTENTIAL CONTRIBUTION OF DESALTING TO FUTURE WATER SUPPLY IN TEXAS.
Southwest Research Inst., Houston, Tex.; and Texas Water Development Board, Austin.

Research and Development Progress Report No 250, Office of Saline Water, United States Dept of the Interior, 26 fig, 19 tab, append. Nov 1966. 197 p. OSW-14-01-0001-603.

Descriptors: *Desalination, *Texas, Water supply, Water quality, Water sources, Costs, Capital costs, Operating costs, Brine disposal, Electrodialysis, Flash distillation, Feasibility.
Identifiers: Conventional water, Texas Water Plan.

On the basis of a unit cost comparison, expressed in terms of cents per thousand gallons, eleven Texas cities have been identified as representative of those which could benefit from future use of a desalting plant. In each, the unit cost for desalting water has been found to be less than or about the same as the unit cost for water from conventional sources. In favor of desalting is the lower initial capital investment required for desalting as compared to the development of conventional water supplies. Although unit costs of both may be relatively close due to higher operating and maintenance costs for desalting, the lower initial capital costs should be of interest to all cities, and especially to those with limited borrowing power. (Winn-Rutgers)
W69-06558

MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
Southwest Research Inst., Houston, Tex.; and Texas Water Development Board, Austin.
Ralph E. Childers, W. Lawrence Prehn, Harold D. Holloway, and Thomas R. Weaver.
Research and Development Progress Report No 257, Office of Saline Water, U S Dept of Interior, 22 fig, 4 tab, append. Nov 1966. 111 p. OSW-14-01-0001-603.

Descriptors: *Desalination, *Texas, *Costs, Water supply, Water quality, Capital costs, Operating costs, Brine disposal, Electrodialysis, Flash distillation.
Identifiers: Conventional water.

This manual describes the procedures developed for calculating total costs for electrodialysis and multistage flash distillation desalting systems and for conventional water supply systems. Information provided on the methodology of all cost calculating procedures used will enable costs to be calculated for any desalting situation. The cost estimating procedure developed for a conventional water supply system includes the cost of a well field or an intake and pumping station at a reservoir or river. The costs of a pipeline with necessary pumping stations and the cost of a conventional water treatment plant. Raw water costs are also considered. In developing a cost estimating procedure for a desalting plant, cost elements include the costs of drilling and completing a water well field, the cost of pumping facilities and a pipeline to the desalting plant, the cost of pretreating salt water, the cost of the desalting plant and the cost of brine disposal. (Winn-Rutgers)
W69-06559

NUCLEAR REACTORS,
California Univ., Berkeley.
Thomas Pigford.
For main entry see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 154-155, Jan 11-13, 1961. 2 p.

Descriptors: *Nuclear energy, Nuclear reactor, Energy, Costs, Water resources, Development.

Nuclear power offers promise of lower fuel cost than conventional fossil fuels. The most likely role of nuclear plants in the water resources program would be as energy sources for seawater conversion and power sources for water pumping stations. It is likely that on economic grounds nuclear plants will be the best selection for these applications in the not too distant future. It is unlikely that the selection of a nuclear power plant over a conventional plant for any of these applications will have any great economic or logistical effect upon the development of water resources in the near future. (Winn-Rutgers)
W69-06582

THE STATUS OF SEA WATER CONVERSION,
California Univ., Berkeley.
Everett D. Howe.
For main entry see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 156-160, Jan 11-13, 1961. 5 p, 1 ref.

Descriptors: *Demineralization, *Water cost, Costs, Desalination, Desalination processes, Water properties, Distillation, Electrodialysis, Reverse osmosis.
Identifiers: Thermal distillation, Cold distillation.

The possible use of desalted water or demineralized brackish water in place of natural waters derived from precipitation in the mountains and transported to the points of use is dependent on the relative costs. Demineralized water can now compete in cost with natural water supplies in a few cases. By continued research and development it may be able to compete favorably with the future costs of imported water and thereby save water users many times the cost of the research program. Some thirty possible processes for demineralizing water have been considered at various times, but only a few have been regarded as potentially economical processes. (Winn-Rutgers)
W69-06583

DESALTED SEAWATER FOR AGRICULTURE: IS IT ECONOMIC,
Resources for the Future, Inc., Washington, D. C.
For primary bibliographic entry see Field 03F.
W69-06765

SUL-biSUL (T) ION EXCHANGE PROCESS: FIELD EVALUATION ON BRACKISH WATERS,
Elgin International, Inc.
K. Schmidt, D. Senger, D. Schwark, and H. Dalaly.
Office of Saline Water, Research and Development Progress Report No. 466. May 1969. 139 p. OSW 14-01-0001-1487.

Descriptors: *Desalination processes, *Ion exchange, Pilot Plant, Cation exchange, Anion exchange, Resins.
Identifiers: *SUL-biSUL (T).

The results of a field evaluation of the Sul-biSul ion exchange process as a mobile pilot plant, transported to different sites, are discussed. Sul-biSul is a two-bed ion exchange resin process which employs a cation exchanger in the regenerated hydrogen ion form, and an anion exchanger in the regenerated sulfate salt form. Waters suitable for treatment by Sul-biSul should not exceed a total dissolved solids content of 2000 ppm as $CaCO_3$; the sulfate-to-chloride ratio should be approximately 9.0; the alkalinity of the water should represent at least 10% of the total anions present; and a gypsum type water containing a high bicarbonate alkalinity is most suitable for optimum performance. For a 1 MGPD 2-bed Sul-biSul plant using 1082 ppm influent as $CaCO_3$, the cost per 1000 gallons of product water of 400 ppm salinity is $0.33. For a 1.5 MGPD plant the cost per 1000 gals. is $0.27. (Rinne-Office of Saline Water)
W69-06836

RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
Aerojet-General Corp., El Monte, Calif.
D. O. DePree, and Herman Weyland.
Office of Saline Water Research and Development Progress Report No. 435. 1969. 54 p. OSW 14-01-0001-1692.

Descriptors: *Brine disposal, *Desalination processes, *Chelation, *By-products, Ion exchange, Sodium compounds, Magnesium compounds, Potassium compounds, Calcium compounds, Brines, Sea water, Ultimate disposal.
Identifiers: Salt recovery, Chelating agents.

A process was investigated and evaluated for the removal of salt from brine effluents. The specific process under investigation was (1) the passage of brine through anion and cation exchange resins to remove all salts; (2) thermal regeneration of anion exchange resins; (3) regeneration of cation exchange resins with chelating agents to preferentially remove certain cations; and (4) acidification of the chelating agents to recover the cation salts. The investigation was concerned with steps (3) and (4) of the process and was limited to determination of the optimum methods and conditions for recovery of sodium, magnesium, potassium and calcium. Amberlite CG-50 resin, loaded with sodium, potassium, magnesium and calcium

ions in the ratio in which they occur in sea water, was eluted with methanol solutions of selected ligands. Extraction with 2-acetylcyclohexanone produced a mixture of potassium and sodium chelates in which the potassium content had been enriched approximately seven fold over the ratio in the resin. Sodium ion free of potassium, magnesium and calcium was then removed from the resin with a methanol solution of acetylacetone. Separation of magnesium and calcium was achieved with a methanol solution of citric acid. Recovery of metal salts by acidification of the chelate solutions was found to be dependent on the concentration of metal chelate. An estimate of the economics of the process is included. (Scott-Office of Saline Water)
W69-06837

INTERMOLECULAR FORCES AND THE LIQUID STATE,
Purdue Univ., Lafayette, Ind.
For primary bibliographic entry see Field 01A.
W69-06838

RECOVERY OF SALTS FROM SALINE WATER VIA SOLVENT EXTRACTION (FINAL REPORT),
Dow Chemical Co., Walnut Creek, Calif.
R. R. Grinstead, J. C. Davis, and S. W. Snider.
Office of Saline Water Research and Development Progress Report No. 406. 1969. 132 p. OSW 14-01-0001-1134.

Descriptors: *Solvent extraction, *By-products, *Magnesium compounds, Sea water, Separation techniques, Organic acid, Brine disposal, Ultimate disposal.
Identifiers: Liquid extraction, Amines, Salt recovery.

The goal of this project was to examine the 'mixed ionic' or 'organic salt' system as a possible means of treating waste brine systems for by-product recovery. The initial phase of this study consisting of the work done during the first year of this contract was reported in a summary report in September 1967. (Office of Saline Water Research and Development Progress Report No. 320). Additional work carried out on the selectivity of simple non-quarternary amine systems gives the usual order of extraction (nitrate greater than bromide greater than chloride) with tertiary amines being most selective and primaries least. Variations in the acid component of the mixed ionic system show the extraction ability in the order carboxylic greater than alkylphosphoric greater than arylsulfonic. Increasing the temperature had little effect on magnesium chloride extraction, but caused a decrease in the distribution of sodium chloride into the organic phase. Preliminary economic estimates are given for the extraction and recovery of magnesium chloride as the solid 6-hydrate from 3X (threefold evaporated) and 10X seawater, and bittern (about 40X). Assuming no feed cost, the process costs vary from $84/ton MgCl2 for the 3X seawater to $35/ton MgCl2 for either 10X or bittern. A number of uncertainities, including the actual cost of a solar distillation step and the size of a magnesium chloride market, make the realization of a credit an unlikely proposition; however, in perhaps a very limited number of cases, a credit can be realized. (Scott-Office of Saline Water)
W69-06839

BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
Rochester Inst. of Tech., N. Y.
Kenneth Hickman, Jer Ru Maa, Peter J. Harris, and Andrew Davidhazy.
Office of Saline Water Research and Development Progress Report No. 392. 1969. 80 p. OSW 14-01-0001-736.

Descriptors: *Evaporation, *Liquids, *Condensation, *Boule flotation, Heat transfer, Films, Surfaces, Air-water interfaces.
Identifiers: Transport coefficient, Liquid-vapor interface, Dissolved gases.

The purpose of the research was twofold: to demonstrate that transport across the clean liquid vapor interface is dependent only on the gas laws and is independent of chemistry--the transport coefficient is unity or nearly so; and to demonstrate that the same liquids (notably water) when stagnant acquire artifacts at the free surface that modify vapor transport and other surface properties. The tools employed were the jet tensimeter for examining new clean surfaces, and the floating liquid boule for probing resting, superheated liquids. It was demonstrated that the condensation (or evaporation) coefficient is unity; and there is little or no resistance to molecules crossing the vapor-liquid interface in addition to that imposed by the gas laws. Experimental results and thermal gradient calculations both showed that in most cases heat transfer in the liquid region is the rate-controlling factor for condensation and evaporation. The floating drop, or 'boule,' was found to be extremely sensitive to trace quantities of impurities, which contaminate and structure the water surface, and impede or prevent boule formation. By adding chemicals to carefully purified water, it was found that a combination of impurities was particularly effective: (1) a film forming substance such as a silicate, and (2) a film stabilizing substance, such as an aluminum, copper or nickel salt. The films which are formed on the water surface constitute a barrier to water evaporation. This work thus offers an explanation of some factors responsible for inhibiting evaporation in distillation processes, and possibilities for control of evaporation from lakes and rivers. (Scott-Office of Saline Water)
W69-06840

3B. Water Yield Improvement

MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
Hebrew Univ., Jerusalem (Israel). Dept. of Irrigation.
For primary bibliographic entry see Field 03F.
W69-06454

IRRIGATION WATER SYSTEM--ISRAEL'S NATIONAL WATER GRID,
Water Planning for Israel Ltd., Haifa.
For primary bibliographic entry see Field 03F.
W69-06459

ON THE DISTRIBUTION OF STATISTICS SUITABLE FOR EVALUATING RAINFALL STIMULATION EXPERIMENTS,
Princeton Univ., N. J.; Stanford Univ., Calif.
K. R. Gabriel, and Paul Feder.
Technometrics, Vol 11, No 1, pp 149-160, Feb 1969. 12 p, 3 tab, 10 ref, append.

Descriptors: *Weather modification, *Cloud seeding, Statistics, Monte Carlo Method, Foreign research, Rainfall, Statistical models, Sampling, *Artificial precipitation, *Statistical analysis, Mathematical models, Meteorology, Statistical methods, Atmospheric precipitation.
Identifiers: Israel, Atmospheric research.

Two randomization tests of the null hypothesis in cloud seeding experiments are compared--the Wilcoxon-Mann-Whitney test and a test based on an average ratio of seeded to nonseeded amounts of precipitation. Data from an Israeli experiment suggest that the latter test is relatively more sensitive to apparent effects of seeding. The significance level of this test may be estimated by the Monte Carlo method, or approximated by using the asymptotic normal distribution of the average ratio. Sampling trials show that this approximation is adequate only when the experiment extends over several years. (USBR)
W69-06679

PHOTOSYNTHESIS AND WATER USE BY SALTCEDAR,
Geological Survey, Lubbock, Tex.
T. E. A. Van Hylckama.
Bull Int Ass Sci Hydrol, Vol 14, No 1, pp 71-83, Mar 1969. 13 p, 7 fig, 15 ref.

Descriptors: *Phreatophytes, *Photosynthesis, *Consumptive use, Evapotranspiration, Evaporation, Carbon dioxide, Tamarisk, Water loss.
Identifiers: Evapotranspirometers.

Near Buckeye, Arizona, saltcedar (Tamarix pentandra) was grown on a battery of evapotranspirometers under various conditions of plant density, soil salinity, and access to water. Growth and development of these plants declined sharply at the beginning of each July, although before that time rates of growth and development had been very high. It was initially postulated that carbon dioxide might have become the limiting factor. Measurements of carbon dioxide content of the air made at different heights inside and outside the evapotranspirometers, however, showed that this was not the case. Analysis of the data shows a close correlation between carbon dioxide and water vapor fluxes (computed by means of mass transfer equations) above the saltcedar thickets. A reduction in fluxes during hot afternoons appears to be due to ambient temperatures over 40 deg C. Water use is similarly affected. (Knapp-USGS)
W69-06771

REGIONAL HYDROLOGIC AREA STUDY AS AN ANALYSIS TOOL IN WEATHER MODIFICATION,
Sierra Hydrotechnology, Placerville, Calif.; and Atmospheric Water Resources Research, Fresno, Calif.
For primary bibliographic entry see Field 02A.
W69-06805

BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
Rochester Inst. of Tech., N. Y.
For primary bibliographic entry see Field 03A.
W69-06840

3C. Use of Water of Impaired Quality

ECONOMIC FRAMEWORK FOR SALINITY CONTROL PROJECTS,
Harvard Univ., Cambridge, Mass.; and Colorado River Basin Project, Denver.
For primary bibliographic entry see Field 05D.
W69-06490

A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS: PART 1,
Brigham Young Univ., Provo, Utah; and Dow Chemical Co., Midland, Mich.
J. J. Christensen, W. F. McIthenney, P. E. Muehlberg, and H. G. Smith.
Research and Development Progress Report No 245, Office of Saline Water, U S Dept of Interior, 55 tab, 24 fig, 405 ref, append. April 1967. 359 p. OSW-14-01-0001-392.

Descriptors: *Brines, *Economic feasibility, Saline water, Brine disposal, Desalination, Feasibility, Economics, Value.
Identifiers: *Mineral recovery, Brine classification.

It is technically feasible to recover most of the various dissolved minerals likely to be encountered in the effluent brines of desalination plants by proven, commercial methods. It is economically feasible to do so only if both the physical conditions and the price of the brines are competitive with other sources of the same mineral. In general, common salt, magnesium hydroxide and bromine are the only materials whose economic recovery looks promising from the effluent brine of a large scale seawater desalination plant. The recovery of potassium compounds from this source may be economically feasible if the concentration factor of the

brine is considerably greater than five. Generally, the disposal costs of the effluent brine from a desalination plant will be decreased if dissolved minerals are recovered. However, this reduction will be modest. (Winn-Rutgers)
W69-06556

3F. Conservation in Agriculture

MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
Hebrew Univ., Jerusalem (Israel). Dept. of Irrigation.
Dan Goldberg.
Int Conf on Water for Peace, Wash, D C, Vol 3, pp 395-406, 1968. 12 p. For the 8 Volume Proc, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *Water management (Applied), *Irrigation efficiency, *Irrigation practices, *Sprinkler irrigation, *Arid lands, Economic efficiency, Irrigation operation and maintenance, Drainage, Land management, Water demand, Water distribution (Applied), Water resources, Water utilization.
Identifiers: *Israel, Irrigation planning.

In arid and semi-arid regions (where most of the developing countries are located) irrigation is about the only means to ensure crop production. Irrigation safeguards crops against drought. Conventional or gravity methods of irrigation in intensive use the world over contain inherent serious limitations, which become particularly apparent when comparing the traditional methods with the more advanced modern irrigation methods. In gravity irrigation, more water is needed per unit area and water accumulates in the subsoil, causing waterlogging and salinity. Preparation of land for proper gravity irrigation is time-consuming, difficult to perform for lack of proper equipment and skilled operators, and very costly. In general, gravity irrigation methods are cumbersome to design, to construct, and to apply. Sprinkler irrigation has been tested in Israel and offers the following advantages: it is easy and quick to install on large areas, unlimited by topography; if properly designed, it offers highly efficient irrigation; the yearly cost of irrigation per unit area compares very favorably with the cost of gravity irrigation; it yields high irrigation efficiencies, or 80% and above, as compared with 20% in gravity irrigation. Practically all irrigation in Israel is done by sprinkling which has proved extremely sucessful. In advocating its adoption, it is suggested that the following measures be taken: standardization of sprinkler irrigation equipment; reduction of the cost of sprinkler equipment by breaking monopolies, encouraging competition, buying in bulk; initiation and support of courses for engineers, technicians and farmers dealing with the proper use and care of the equipment. (Knapp-USGS)
W69-06454

IRRIGATION WATER SYSTEM--ISRAEL'S NATIONAL WATER GRID,
Water Planning for Israel Ltd., Haifa.
A. Wiener.
Int Conf on Water for Peace, Wash, D C, Vol 7, pp 195-205, 1968. 11 p. For the 8 Volume Proc, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *Water management (Applied), *Water conservation, *Irrigation operation and maintenance, Arid lands, Water quality, Artificial recharge, Conjunctive use, Drainage, Land management, Non-structural alternatives, Water demand, Watershed management, Desalination, Water utilization.
Identifiers: *Israel, Groundwater management, Comprehensive water plans.

Distribution and availability of water has always had a decisive influence on the economic and cultural development of Israel. Ancient responses to the problems of water scarcity cannot be used to solve present problems because of the deterioration through neglect of large areas of land and the different claims we now make on productivity and dependability of agriculture. In Israel's long-term plans an attempt was made to define a development policy for water quantity, quality, and distribution. Between 1948 and 1966, water utilization rose from 17% to almost 90% of the country's proven potential resources, the extent of irrigated land from 70,000 to over 400,000 acres, and agricultural production seven-fold, to US $450 million. More than half of Israel's farmers started farming in the past 15 yr, mostly with no previous farming experience, but agricultural productivity is high, and water utilization is nearly at its limit. The physical system that has evolved is a fully integrated national water grid. Practically all potential water sources (including reclaimed wastes) will be in use by the early 1970's. Further economic development will then depend on the introduction of man-made water, improving the quality of natural waters, or on the shift of water resources from lower-value to higher-value use, or on a combination of these approaches. (Knapp-USGS)
W69-06459

AGRICULTURE USE OF WATER IN TAIWAN, REPUBLIC OF CHINA,
Taiwan Provincial Government, Taipei. Water Conservancy Bureau.
Liu Fong-yih.
Int Conf on Water for Peace, Wash, D C, Vol 7, pp 220-230, 1968. 11 p, 1 fig, 4 tab. For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *Water resources development, *Irrigation, Conservation, Governments, Institutions, Legislation, Optimum development plans, Political aspects, Economies, Water allocation (Policy), Water requirements, Water utilization.
Identifiers: Taiwan, Rotational cropping, Rotational irrigation.

Taiwan is a densely populated island of 35,800 sq km whose people depend largely on agriculture for a livelihood. Rainfall is abundant but very uneven in distribution. Mountains are numerous and steep; rivers are short and rapid. Under such conditions flood and drought are the essential problems of water resources development. About 889,000 ha of the island are in cultivation and 60% of this is irrigated. Soils of cultivable areas are mostly in the Cenozoic alluvium belt with laterites below. Alluvial deposits are mixed with gravels, sand and clay, and are generally high in fertility. In the early stage of water development, direct diversion of natural stream-flow was the common type of irrigation. As the irrigation area had to be increased with time and population, utilization of the natural flow gradually reached a limit. In order to store water for irrigation to even out the fluctuations in rainfall, farm ponds and reservoirs have been built. Reservoir storage requires large capital investment and as an alternative, a groundwater development plan has been implemented to serve as a source of irrigation water supply. In order to save water so as to extend the irrigated area, cooperative farmer irrigation associations, rotational cropping, rotational irrigation, and low cost canal lining have been adopted. In addition, the study of irrigated upland farming crops, which respond favorably to water and contribute high economic value, has been promoted by the Government in order to advance economic development. (Knapp-USGS)
W69-06460

ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
Bureau of Reclamation, Denver, Colo. Experimental Design Analysis Section; and Bureau of Reclamation, Denver, Colo. Water Utilization Branch.
For primary bibliographic entry see Field 02F.
W69-06509

DISPLACEMENT FRONT UNDER PONDED LEACHING,
California Univ., El Centro. El Centro Field Station.
For primary bibliographic entry see Field 02G.
W69-06510

EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
Southwestern Great Plains Research Center, Bushland, Tex.
A. D. Schneider, J. T. Musick, and D. A. Dusek.
Transactions of the ASAE, Vol 12, No 1, pp 23-26, Jan 1969. 5 fig, 4 tab, 7 ref.

Descriptors: *Irrigation efficiency, *Wheat, *Crop production, *Water utilization, *Growth stages, Timing, Soil moisture, Irrigation water, Texas, Plant physiology, Moisture stress, Moisture deficit, Soil-water-plant relationships, Winter, Rates of application, Moisture availability, Precipitation (Atmospheric).

A study was conducted at Bushland, Texas during 3 wheat seasons to determine the combinations of spring irrigations at 4 selected stages of plant development that produced the best water-use efficiencies and to determine some effects on yields and plant development caused by delaying or deleting irrigations. The study showed that irrigation timing was critical when less than an optimum amount of water was applied to winter wheat. Every number and timing of the 4 irrigations was used so that the effect of any combinations of irrigations could be evaluated. The most critical period for adequate soil moisture was from booting through early grain filling. Moderate soil-moisture stress during early spring did not reduce yields appreciably if soil moisture was adequate during this critical period. (Affleck-Ariz)
W69-06511

DROUGHT AND SOIL MOISTURE,
Hydrometeorological Service of the USSR (Moscow).
For primary bibliographic entry see Field 02G.
W69-06529

EVAPORATION REDUCTION ON LARGE RESERVOIRS,
Utah State Univ., Logan; Utah Engineering Experiment Station, Salt Lake City; and Utah Water Research Lab., Logan.
C. Earl Israelsen, and Vaughn E. Hansen.
Proc American Soc Civil Engineers, Vol 91, No IR1, paper 4262, pp 93-98, March 1965. 5 ref.

Descriptors: *Reservoir evaporation, *Evaporation control, *Monomolecular films, *Aircraft, *Application equipment, Equipment, Spraying, Rates of application, Retardants, Lakes, Chemcontrol, Particle size, Films, Alcohols, Heating, Liquids.
Identifiers: *Powder, *Dispensers.

Descriptions were given of equipment developed by Utah State University for dispensing evaporation retardants in liquid and powder form from aircraft. Monolayer film covers could be obtained by applying material at rates between 0.05 and 0.30 lb per acre. Applications using the newly developed equipment to spread monolayer-forming chemicals on several large lakes in Utah, Idaho, Wyoming and New Mexico were summarized. Observations and recommendations concerning equipment, procedures and continuing research were also presented. (Blecker-Ariz)
W69-06531

TRANSPIRATION REDUCTION BY SURFACE FILMS,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Meteorological Physics.
D. E. Angus, and H. Bielorai.
Aust J Ag Research, Vol 16, No 2, pp 107-113, March 1965. 1 fig, 1 tab, 1 photo, 9 ref.

Descriptors: *Transpiration control, *Monomolecular films, *Plant growth, *Surfactants, *Foliar application, Transpiration, Damages,

Sprays, Leaves, Alcohols, Films, Chemcontrol, Wetting.
Identifiers: *Oils, *Silicones, Sunflowers.

Exploratory tests on the possibility of reducing plant transpiration by means of surface films were described. When cetyl alcohol was sprayed on sunflower plants, it reduced transpiration significantly but caused considerable damage to plants. Low viscosity silicone oils reduced transpiration by about 50% and caused only marginal growth abnormalities on sunflower plants. Application of wetting agents combined with silicones caused less reduction in transpiration and in the transpiration ratio and had no visible effect on the leaves. Comparison of data with other work where film-forming material were added to the root medium of plants suggested that foliar application was preferable to root application. Runoff from arid watersheds might be increased by application of transpiration suppression agents on vegetation of these areas. (Blecker-Ariz)
W69-06532

SOILS STUDIES USING COLOR PHOTOS,
McGill Univ., Montreal (Quebec).
For primary bibliographic entry see Field 07B.
W69-06696

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
Vsesoyuznyi Nauchno-Issledovatelskii Institut Gidrotekhniki i Melioratsii, Moscow (USSR).
V. E. Bobchenko, and A. A. Sydko.
9th Int Congr Soil Sci, Trans, Vol 1, pp 443-453, Adelaide, Australia, 1968. 11 p, 3 fig, 2 tab.

Descriptors: *Saline soils, Salinity, Salts, *Leaching, Soils, Rice, Foreign research, *Land reclamation, *Alkaline soils, Arid lands, Soil chemical properties, Drainage, Irrigable land, Cotton.
Identifiers: *Golodnaia Steppe (USSR), *Soil reclamation, Drain spacing, USSR.

Soil research was performed in the Golodnaya Steppe, USSR, to determine effective measures for accelerated irreversible desalinization of the virgin lands now being developed. Soils containing up to 1% toxic salts and having a seepage factor of 2-4 m/day were desalted by drainage and leaching at the rate of 8,200-71,000 cu m/ha (gross). The soils were desalinized to a depth of 0.7-9.5 m during 1-5 mo; the amount of unleached toxic salts within this depth was below the damaging limit. Increasing the leaching rate results in an increase in the amount of water that must be delivered for each consequent unit of salt removal and delays the progress of land reclamation, making capital investments less profitable. Application of very high leaching rates is economically unfeasible. Very low leaching rates are economically unfeasible because they do not provide for sufficient soil desalinization nor for beneficial crop yields. Measures are recommended for preventing secondary salinization of the leached soils and further desalinization in the lower horizons. At high rates, leaching during rice cultivation provides for deep desalinization of soil and quick repayment of capital investments. (USBR)
W69-06716

SALT BALANCE AND SALT TRANSPORT PROCESSES IN IRRIGATED SOILS,
National Inst. for Agricultural Quality Testing Budapest (Hungary).
I. Szabolcs, and K. Darab.
9th Int Congr Soil Sci, Trans, Vol 1, pp 491-502, Adelaide, Australia, 1968. 12 p, 4 tab, 14 ref.

Descriptors: *Salts, *Salt balance, *Irrigated land, Soils, *Leaching, Irrigation water, Saline water, Salinity, Water quality, Soil profiles, *Soil science, Soil physical properties, Soil chemical properties, Alkali soils, Alkalinity, Saline soils.

Exact knowledge of the salt dynamics of soils, regardless of whether they are irrigated or not, is important. The nature of changes in soils following various methods of amelioration, irrigation, and crop production, may be revealed when the salt balance is studied. An understanding of these changes is necessary for prevention of secondary salinization. If the salt dynamics of soils is expressed in the salt balance, changes in salt content of soils expected in one or more years may be calculated approximately. The permissible maximum salt concentration of the irrigation water may be determined for any soil from a study of the salt balance. If the salt balance is negative, leaching of the soil is effective and the salt concentration in irrigation water is lower than that required for maintaining equilibrium. If the salt balance is positive, the amount of salt retained in the soil is higher than that leached out by irrigation water. If the salt balance is positive and salts accumulate in the surface layer, the primary source of these salts is saline ground water and not irrigation water. A formula is given for calculating the salt regime constant. The amount and salt concentration of the irrigation water necessary for maintaining the existing salt content or for inducing a predetermined change may then be computed. (USBR)
W69-06717

WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
Ministry of Agriculture, Wad Medani (Sudan). Research Div.
D. A. Rijks.
Journ of Applied Ecology, Vol 5, No 3, pp 685-706, Dec 1968. 22 p, 14 fig, 2 tab, 30 ref, 1 append.

Descriptors: *Water utilization, *Radiation, *Cotton, *Crop response, *Solar radiation, Measurement, Heating, Fluctuation, Diurnal, Meteorrological data, Soil temperature, Seasonal, Soil-water-plant relationships, Thermal properties, Energy budget, Irrigation, Air masses, Surfaces, Cover crops.
Identifiers: *Sudan, Soil heat, Net radiation, Long-wave radiation.

Investigations into use of water by cotton crops in the Sudan Gezira were made during the 1965-66 season. This paper deals mainly with seasonal and diurnal patterns of incoming and outgoing long-wave radiation, net-radiation and soil heat-flux. Net long-wave loss was affected equally by the radiating surface and overlying airmass. It decreased as crop cover increased and when irrigations were given early in the season. Net radiation was approximately proportional to incoming short-wave radiation because effects of a developing crop cover, decrease in solar altitude and change in the overlying airmass on reflected short-wave radiation and on net long-wave loss were approximately self-cancelling. The seasonal pattern of soil heat-flux was dominated by the increase in crop cover. (Affleck-Ariz)
W69-06756

THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Agricultural Meteorology.
G. Stanhill, J. T. H. Cox, and S. Moreshet.
Journ of Applied Ecology, Vol 5, No 3, pp 707-720, Dec 1968. 4 fig, 6 tab, 28 ref.

Descriptors: *Climatology, *Crop response, *Irrigation effects, *Radiation, *Albedo, Corn (Field), Seasonal, Diurnal, Variability, Air temperature, Vapor pressure, Soil water, Soil-water-plant relationships, Heating, Solar radiation, Cloud cover, Leaves, Plant growth.
Identifiers: *Israel, *Short-wave radiation, *Long-wave radiation.

This paper presents results of an investigation of seasonal and diurnal variation in the radiative characteristics of irrigated maize in Israel. Loss of short-wave radiation by reflection from the maize crop averaged 0.18 of the incident total short-wave radiation received during the growing season. Net long-wave radiation loss from the crop averaged 0.35 of the incident total short-wave radiation received during the growing season. Seasonal variation in this component was small, but diurnal variation averaged 20%. Variation in sky radiation showed little correlation with air temperature and even less with air vapour pressure, but closely followed the diurnal pattern of cloud cover. Both short and long wave components of the radiation balance were unaffected by soil water content and irrigation treatment within the range examined by the study. (Affleck-Ariz)
W69-06757

DESALTED SEAWATER FOR AGRICULTURE: IS IT ECONOMIC,
Resources for the Future, Inc., Washington, D. C.
Marion Clawson, Hans H. Landsberg, and Lyle T. Alexander.
Science, Vol 164, No 3884, pp 1141-1148, June 6, 1969. 8 p, 23 ref.

Descriptors: *Desalination, *Economics, *Water costs, Nuclear powerplants, Irrigation programs, Costs, Multiple-purpose projects, Industrial plants, Water supply, Irrigation water, Water distribution (Applied), Water rates, Direct costs, Economics of scale, Government finance, Interest, Power marketing, Social aspects.
Identifiers: *Agro-industrial complexes.

The economics of desalting sea water on a very large scale for commercial agriculture in arid lands is reviewed. Proposals for integrated nuclear agro-industrial complexes treat water cost as residual after the profitable use of electricity, but project feasibility must be based on profitability of the whole operation, not on a heavily subsidized price of one product. Even in Southern California today, where water is scarce and imported at high cost, and there is a ready market for electricity, a proposed desalting-power plant had to be shelved because construction cost, interest, and production costs made the project uneconomic. The lowest cost plant now operating (Key West, Fla), produces water for 83 cents per 1,000 gal with a subsidized interest-rate construction loan. In a proposed agro-industry plant in Israel, an interest rate of 1.9% yields a water cost of 40 cents per 1,000 gal, and use of a 10% rate (lower than Israel's current rate) results in water cost of $.90-$1.00 per 1,000 gal. Combined plants operate efficiently only at a constant output, and agricultural use is the most highly seasonal of uses, so inefficency cost, transportation cost, storage cost, and evaporative loss must be added to water production cost. These costs, conservatively estimated, will add over $34 per ac-ft to the cost of raw water. In Central Arizona, an already highly developed area, irrigation water value is less than $21 per ac-ft; why expect it to be higher in underdeveloped areas. A reasonable guess is that in an underdeveloped area, water is worth only $10-$30 per ac-ft (3-10 cents per 1,000 gal). This is a whole order of magnitude lower than the cost of desalted water. Research may solve this problem, and should be done, but no present or near-future solution is at hand. (Knapp-USGS)
W69-06765

PROCEEDINGS OF TILE DRAINAGE RESEARCH CONFERENCE,
Cooperative State Research Service, Washington, D. C.
For primary bibliographic entry see Field 04A.
W69-06795

CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Irrigation Engineering; and Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.

Arthur Thomas Corey, and William D. Kemper.
Colo State Univ Hydrol Pap No 30, Sept 1968. 23 p, 9 fig, 6 tab, 7 ref. Projects W-32 and W-73 (Exp Sta).

Descriptors: *Infiltration, *Surface-groundwater relationships, *Recharge, *Mulching, Evaporation, Infiltrometers, Soil water movement, Water management (Applied), Hydrologic budget.
Identifiers: *Gravel mulches.

Results of studies to discover methods of reducing evaporation from soils, conducted at Colorado State U since 1956, show that a gravel mulch on a fallow soil surface is the most promising method for increasing infiltration. The use of a gravel mulch 5 cm thick resulted in an additional infiltration of 14 inches of water in a year compared to infiltration under bare soil. Interactions between soils, gravel sizes, radiation and winds are shown graphically. (Knapp-USGS)
W69-06796

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

SAFETY CONTROL OF PRIVATE DAMS,
New England River Basins Commission, Boston, Mass.
Robert Restall.
New Engl River Basins Comm Tech Rep No 1, Jan 1969. 32 p, 3 tab, 3 append.

Descriptors: *Reservoir operation, *Regulation, *New England, *Safety, *Operation and maintenance, Legislation, Governments, State governments, Water law, Legal aspects, Dams, Dam failure, Dam design, Dam construction.
Identifiers: *Dam safety.

Hazards caused by unsafe privately-owned dams are reviewed and recommendations for regulation to promote safe construction, operation, and maintenance are made. Applicable state laws are discussed. All designs should be prepared, and construction of dams performed, under the direction of a professional engineer. The permit should specify certain stages in the construction when the control agency must be notified. The professional engineer must certify upon completion of the dam that a safe dam was constructed to accepted standards. The responsibility for proper maintenance and repair would be recorded as a condition of the permit. The dam owner could be responsible for recording the permit in the registry of deeds within a limited time. Permits would be issued for definite periods of time with inspections and other investigations occurring near the end of the period. (Knapp-USGS)
W69-06433

RURAL WATER DEVELOPMENT IN KENYA,
Department of Water Development (Kenya).
R. Barrett, and G. Classen.
Int Conf on Water for Peace, Wash, D C, Vol 1, pp 476-487, 1968. 12 p, 1 tab. For the 8 volume Proc, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *Water resources development, *Rural areas, Water resources, Surface waters, Groundwater, Rainfall, Streamflow, Dams, Reservoirs, Water storage, Water wells, Climates, Weather, Evaporation.
Identifiers: Kenya, Rural water development.

Kenya lies astride the Equator, and stretches inland from the Indian Ocean to Lake Victoria. Differences in climatic conditions are caused mainly by variations in altitude. Along the coastline is a narrow tropical belt behind which is desert. Inland the influence of mountains changes the climate to subtropical and temperate. Rainfall varies from 10 in. in the desert to over 100 in. in the major hills. Above the 30 in. isohyet the country is generally hilly and often precipitous, and numerous springs and perennial streams occur. In the East, such streams tend to taper as they reach the lower and drier zone where they disappear in alluvial cones or in the large seasonal sand rivers. The Great Rift Valley has an internal drainage system. Below the 30 in. isohyet, the country is flatter, drier and much hotter, and evaporation is about 100 in. per yr. Extensive groundwater resources are largely underdeveloped. Sub-surface dams have wide application in dry areas. By constructing concrete barriers across such sand beds at favorable sites, the underflow in the sand is retarded and brought near the surface for easier development. Small earth dams and stock tanks are built by hand and by mechanical means. Some 2,000 dams and tanks have been built to date; but very many more are required to serve the pastoral areas. Spring protection and well construction are used in groundwater development. (Knapp-USGS)
W69-06453

THE POSSIBILITY OF USING A MOVABLE DAM: THE 'FABRIDAM' AND ITS APPLICATION IN ARID REGIONS,
Plan Organization (Iran). Water Planning Group.
M. Vahidi.
Int Conf on Water for Peace, Wash, D C, Vol 3, pp 423-430, 1968. 8 p, 2 tab. For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *Dams, *Dam design, *Movable dams, Arid lands, Water supply, Water control, Water storage, Recharge, Flood control, Irrigation.
Identifiers: *Iran, Fabridam, Fabric dams, Inflatable dams.

Iran is an arid region, with 25-30 centimeters mean annual rainfall which may be compared with a figure of 86 cm for the entire globe. Consequently most rivers of the country are intermittent, with high variability of their small amount of streamflow. The flow is high in late winter and early spring and very low in summer, and during the low flow and flood periods the full capacity of the rivers cannot be utilized directly. One of the common techniques used for diverting streams in low flow is use of temporary dams such as brush dams or flash boards which are washed off by the first flood. In the last few decades many types of movable dams and crests such as stop logs, vertical lift gates, radial gates, rolling gates, bear trap gates and drum gates have been employed for the purpose and operate as diversion dams or crest control devices. All of these movable control devices require lifting power, a bridge or overhead cableway, hoisting cable, and piers. As a result they create some obstruction for flood flows and are very expensive for small and medium size movable dams. The Fabridam is an inflatable dam adapted for installation on any stream, river or waterway, and consists of neoprene coated fabric; when deflated there will be no resistance to flood flow. A 4-ply sheet of fabric has a tensile strength of 400 kg per linear cm, and weight of the material is 7 kg per sq m. Fabridam is most practical in arid regions, because of diversion of water in low flow periods and recharging the groundwater in flood periods. Costs of materials used for installations are generally less than 1/2 to 1/3 of concrete and steel. (Knapp-USGS)
W69-06455

CONSTRUCTION AND MANAGEMENT OF RIVER VALLEY PROJECTS IN INDIA,
Ministry of Irrigation and Power (India).
K. P. Mathrani.
Int Conf on Water for Peace, Wash, D C, Vol 5, pp 321-333, 1968. 13 p, 1 tab. For the 8 Volume Proc, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *Irrigation programs, *River basin development, *Government supports, History, Long-term planning, Future planning (Projected), Irrigation, Arable land, Irrigable land.
Identifiers: *India.

Although the irrigation function is assigned to the states of India, the Indian Government has been taking much interest in the scientific aspects of irrigation development since independence. The Ministry of Irrigation and Power reviews progress on projects and assists in removing bottlenecks as they develop. The Government emphasizes scientific management of water resources by organizing meetings, seminars, and study groups. At the time of partition in 1947, the irrigation potential was 47 million acres, but 36 million acres were added in the next 18 yr. Plans on hand envisage an addition of 40 million acres during the next 10 yr, and 200 million acres should be exploited within 20 or 25 yr. (Vorhis-USGS)
W69-06457

A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
Central Water and Power Commission (India).
D. B. Anand, and S. Balasubramaniam.
Int Conf on Water for Peace, Wash, D C, Vol 7, pp 403-411, 1968. 9 p, 9 ref, 1 append. For the 8 Volume Proc, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *History, *Irrigation, *Dams, *Canals, Foundations, Pozzolans, Dam design, Earth dams, Irrigation engineering, Construction.
Identifiers: *India, Grand Anicut.

Among Indian irrigation works several thousand yr old, a large number of tanks are still functioning. The Grand Anicut across the Cauvery was built in the second century A.D. Large irrigation projects, including the Western and Eastern Jumna Canals and the Cauvery Delta System were begun in the early 19th century. Late in the 19th century the Godaveri Diversion Scheme, the 100-ft high Khadakwasla Dam, and the 176-ft high Periyar Dam were built. The early storage structures were in the central and southern parts of the country where foundations are nearly ideal and the streamflows need regulation. Present-day canal design draws heavily from early studies by Kennedy, Lacey, and Khosla on structures in alluvial terrain. Canals are now designed and constructed for discharges over 20,000 cusecs with linings to minimize transit losses and eliminate water-logging. After the Second World War came construction of medium to large storage structures planned for multiple uses. In the design of earlier masonry dams, the foundation conditions, together with the traditionally available building skill (stone masonry), dictated gravity dams. Advances being made in foundation treatment and construction of cutoff and the availability of suitable construction machinery have led to a greater use of earth and rockfill dams. Modern Portland cement brought about use of mortar. Pozzolans were in use in the country from very early times. Mention has been made of calcined clay, shale and fly ash. (Vorhis-USGS)
W69-06461

FLOOD PLAIN INFORMATION, WILSON CREEK AND TRIBUTARIES, SPRINGFIELD, MISSOURI-PART 1.
Corps of Engineers, Little Rock, Ark.

Corps Eng Flood Plain Rep, Nov 1968. 40 p, 22 fig, 26 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Missouri, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Wilson Creek (Missouri), Springfield, Intermediate regional flood, Standard project flood.

Flooding of Wilson Creek and tributaries, Springfield, Missouri is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may

be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06467

FLOOD PLAIN INFORMATION, ROCKY RIVER IN CITIES OF ROCKY RIVER AND LAKEWOOD, CUYAHOGA COUNTY, OHIO.
Corps of Engineers, Buffalo, N. Y.

Corps Eng Flood Plain Rep, July 1968. 54 p, 44 fig, 8 plate, 10 tab.

Descriptors: *Floods, *Flood damage, *Ohio, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Rocky River (Ohio), Lakewood, Cuyahoga County, Standard project flood, Intermediate regional flood.

Flooding of Rocky River in the cities of Rocky River and Lakewood, Cuyahoga County, Ohio is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06468

FLOOD PLAIN INFORMATION, WALLA WALLA RIVER TRIBUTARIES IN THE VICINITY OF WALLA WALLA, WASHINGTON.
Corps of Engineers, Walla Walla, Wash.

Corps Eng Flood Plain Rep, June 1968. 35 p, 9 fig, 23 plate, 4 tab.

Descriptors: *Floods, *Flood damage, *Washington, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Walla Walla (Wash), Walla Walla River, Standard project flood, Intermediate regional flood.

Flooding in the vicinity of Walla Walla, Washington is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06469

FLOOD PLAIN INFORMATION, YAKIMA RIVER, BENTON COUNTY, WASHINGTON.
Corps of Engineers, Seattle, Wash.

Corps Eng Flood Plain Rep, Mar 1968. 37 p, 8 fig, 17 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *Washington, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Benton County (Wash), Yakima River, Standard project flood, Intermediate regional flood.

Flooding of the Yakima River, Benton County, Washington is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06470

FLOOD PLAIN INFORMATION, OMAHA METROPOLITAN REGION, NEBRASKA - VOLUME I.
Corps of Engineers, Omaha, Nebr.

Corps Eng Flood Plain Rep, Nov 1967. 48 p, 3 exhibits, 20 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Nebraska, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Omaha (Nebr), Papillion Creek, Standard project flood, Intermediate regional flood.

Flooding of Papillion Creek, Omaha, Nebraska is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06471

FLOOD PLAIN INFORMATION, CEDAR RIVER, LINN COUNTY, IOWA.
Corps of Engineers, Rock Island, Ill.

Corps Eng Flood Plain Rep, Oct 1967. 62 p, 19 fig, 22 plate, 7 tab.

Descriptors: *Floods, *Flood damage, *Iowa, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Linn County (Iowa), Cedar Rapids (Iowa), Cedar River, Standard project flood, Intermediate regional flood.

Flooding of the Cedar River, Linn County, Iowa is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06472

FLOOD PLAIN INFORMATION, GUAYANILLA RIVER, GUAYANILLA, PUERTO RICO.
Corps of Engineers, Jacksonville, Fla.

Corps Eng Flood Plain Rep, Oct 1967. 29 p, 4 fig, 8 plate, 6 tab.

Descriptors: *Floods, *Flood damage, *Puerto Rico, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Hurricanes, Historic flood.
Identifiers: Guayanilla River (Puerto Rico), Standard project flood, Intermediate regional flood.

Flooding of the Guayanilla River in Guayanilla, Puerto Rico, is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06473

SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE.
Texas Water Development Board, Austin; and Water Resources Engineers, Inc., Lafayette, Calif.

Interim Progress Report, Dec 23, 1968. 42 p, 14 fig, 2 tab, 2 ref, 1 append.

Descriptors: *Simulation analysis, *Water management (Applied), *Water resources development, *Systems analysis, Future planning (Projected), Mathematical models, Optimization, Constraints, Water conveyance, Water allocation (Policy), Reservoir operation, Timing, Networks, Digital computers.
Identifiers: *Out-of-kilter algorithm, Link-node networks, Texas.

An interim report was made on the state of development of a systems study of the future Texas reservoir-river-canal water distribution problem. Four models were described, the first three progressively acting as screening models for the increasingly constrained following models. The models were link-node network models which solved for the allocation of water throughout the system, subject to known inputs and demands, using an 'out-of-kilter' algorithm to obtain fast digital computer solutions. The objective of the study was to determine the optimal timing of reservoir and canal construction with future water imports from the Mississippi River. Seasonal water demands, evaporation rates and reservoir capacities were assumed known. Several response surface searching methods used in the final allocation model were described. (Gysi-Cornell)
W69-06494

RESERVOIR MANAGEMENT: THE TRADEOFF BETWEEN LOW-FLOW REGULATION AND FLOOD CONTROL,
Federal Water Pollution Control Administration, Washington, D. C.
G. K. Young.
Water Resources Res, Vol 4, No 3, pp 507-511, June 1968. 5 p, 2 fig, 6 ref.

Descriptors: *Linear programming, *Reservoir operation, *Low-flow augmentation, *Flood control, Water management (Applied), Probability, Water quality control, Water policy, Flow control, Optimization.
Identifiers: Rule curves.

The results of a linear programming study which found optimal operating policies for a hypothetical low-flow augmentation-flood control reservoir, were given. The objective of the study was to find operation schemes that minimized expected losses, which were specified so that low-flow penalities were considered along with flood losses. Discrete inflow probabilities, and low-flow and flood penalty functions were assumed known. Solutions for the example were given that indicated the degree to which flood and water quality control were complementary. It was concluded that even if the low-flow penalty is known only within a range, the optimal policy (rule curve) can often be determined. (Gysi-Cornell)
W69-06496

SBARRA V ERIE RR (DRAINAGE OF SURFACE WATERS AND PRESCRIPTIVE RIGHTS).
For primary bibliographic entry see Field 06E.
W69-06591

NASSAU COUNTY V CHERRY VALLEY ESTATES, INC (OBSTRUCTION OF ALLEGED WATER COURSE).
For primary bibliographic entry see Field 06E.
W69-06592

SAMYN V TACEY (ARTIFICIAL DRAINAGE OF SURFACE WATERS).
For primary bibliographic entry see Field 06E.
W69-06593

CANNON V CITY OF MACON (NATURAL DRAINAGE FLOW AND THE LOWER LAND PROPRIETOR).
For primary bibliographic entry see Field 06E.
W69-06595

COX V MARTIN (DISCHARGE OF SURFACE WATER THROUGH A DOWNSPOUT).
For primary bibliographic entry see Field 06E.
W69-06596

DRAPER V MOSHIER (INTERFERENCE WITH DRAINAGE DITCH).
For primary bibliographic entry see Field 06E.
W69-06600

CITY OF PORTSMOUTH V CULPEPPER (SUIT FOR DAMAGES RESULTING FROM OVERFLOW OF OBSTRUCTED CANAL).
For primary bibliographic entry see Field 06E.
W69-06602

ZOMBKOWSKI V WISCONSIN RIVER POWER CO (FLOODING DAMAGES CAUSED BY DAM CONSTRUCTION).
For primary bibliographic entry see Field 06E.
W69-06603

LEONARD V STATE HIGHWAY DEPT (ACQUISITION OF TITLE BY STATE THROUGH PERMANENT FLOODING OF LAND).
For primary bibliographic entry see Field 06E.
W69-06611

BALL CREEK COAL CO V NAPIER (MEANDERS AS A BOUNDARY).
For primary bibliographic entry see Field 06E.
W69-06614

FRODERMAN V DIETZ (PRIVATE DAMS FOR FLOOD CONTROL).
For primary bibliographic entry see Field 06E.
W69-06617

KANSAS CITY LIFE INS CO V UNITED STATES (IMPAIRMENT OF LAND VALUE DUE TO DAM CONSTRUCTION).
For primary bibliographic entry see Field 06E.
W69-06623

CLEMENTS V TOWN OF CARROLLTON (DAM ACROSS DRAINAGE DITCH).
For primary bibliographic entry see Field 06E.
W69-06627

FLOOD WALL BOARD.
For primary bibliographic entry see Field 06E.
W69-06647

HANCOCK V STULL (INTERFERENCE WITH NATURAL DRAINAGE OF SURFACE WATER).
For primary bibliographic entry see Field 06E.
W69-06652

RINZLER V FOLSOM (ARTIFICIAL INCREASE OF SURFACE RUNOFF).
For primary bibliographic entry see Field 06E.
W69-06657

HEC-2, WATER SURFACE PROFILES.
Corps of Engineers, Sacramento, Calif.

Corps Eng Hydrol Eng Center Computer Program 22-32, Dec 1968. Total 141 p, 1 tab, 5 ref, 13 exhibit.

Descriptors: *Mathematical models, *Flow profiles, *Channel flow, *Computer programs, Digital computers, Mannings equation, Roughness (Hydraulic), Discharge measurement, Regime.
Identifiers: *Water surface profiles.

A digital computer program computes and plots the water surface profile for river channels of any cross section for flows greater or less than critical. The effects of various hydraulic structures such as bridges, culverts, weirs, embankments, and dams may be considered in the computation. River conditions such as variable channel roughness, islands, bends, levee overflow, river confluences, and waterfalls may also be included. Investigating channel roughness from known high water marks is one of several special program applications. Input may be in either English or Metric units. The method applies Bernoulli's theorem for the total energy at each cross section and Manning's formula for the friction head loss between cross sections. (Knapp-USGS)
W69-06787

HEC-3, RESERVIOR SYSTEM ANALYSIS.
Corps of Engineers, Sacramento, Calif.

Corps Eng Hydrol Eng Center Computer Program 23-53, Dec 1968. Total 96 p, 6 exhibit.

Descriptors: *Mathematical models, *Systems analysis, *Routing, *Reservoir operation, Economics, Water costs, Water values, Water utilization, Flood control, Multiple-purpose reservoirs, Computer programs.
Identifiers: *Reservoir system analysis, Reservoir management.

A program written in Fortran IV performs a multipurpose, multireservoir routing of a reservoir system by any number of periods of uniform or varying length per year based on flow requirements at reservoirs, diversions, and downstream control points and power requirements at reservoirs. It can accept any configuration of reservoirs, diversions, power plants and control points, and will accept system power demands that over-ride individual power plant requirements, but does not provide for channel routings, percolation losses or time translations. It can assign economic values to all outputs and summarize and allocate these in various ways. All requirements are supplied from reservoirs so as to maintain a specified balance of storage in all reservoirs. At reservoir stages below specified levels, releases from storage at each reservoir are reduced to a secondary specified flow at each control point until all active storage is withdrawn. Provision is included for shortage declaration which will reduce desired flows and diversions covering a period less than 1 year. A listing of the source program is included in exhibit 4. (Knapp-USGS)
W69-06788

PROCEEDINGS OF TILE DRAINAGE RESEARCH CONFERENCE,
Cooperative State Research Service, Washington, D. C.
Arthur F. Pillsbury.
Calif Univ Water Resources Center Rep No 15, Proc of Tile Drainage Conf, Nov 18-20, 1968, El Centro, Calif, 1968. 59 p, 3 fig, 7 tab, 20 ref.

Descriptors: *Drainage, *Drainage systems, *Tile drainage, Subsurface drainage, Surface-groundwater relationships, Drainage effects, Drainage engineering, Water management (Applied), Land reclamation, Leaching, Saline soils, Salinity.
Identifiers: *Soil salinity control, Tile drainage systems.

Tile drainage is a strong effective means of managing river-basin irrigation salt balance, probably the most critical long-term management problem of the arid southwest US. Research on tile drainage conducted by USDA, Water districts, Universities, and State agencies is summarized in a conference at El Centro, Cal. Topics discussed include progress in reducing laying costs, collapse or deformation of pipes, problems of grade control, problems of sedimentation, problems of Mn and Fe oxide deposition, problems of reclamation of slowly permeable soils, enveloping techniques and materials, and cleaning of tile lines. (Knapp-USGS)
W69-06795

FLOOD PLAIN INFORMATION, BOISE RIVER AND NORTHSIDE TRIBUTARIES, BOISE, IDAHO AND VICINITY.
Corps of Engineers, Walla Walla, Wash.

Corps Eng Flood Plain Rep, Oct 1967. 53 p, 24 fig, 22 plate, 3 tab.

Descriptors: *Floods, *Flood damage, *Idaho, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Boise (Idaho), Boise River, Standard project flood, Intermediate regional flood.

Flooding of the Boise River and tributaries, Boise, Idaho is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06823

FLOOD PLAIN INFORMATION OF SPRING VALLEY CREEK, SAN DIEGO COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.

Corps Eng Flood Plain Rep, Sept 1967. 29 p, 7 fig, 19 plate, 6 tab.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: San Diego County (Cal), Spring Valley Creek (Cal), Standard project flood, Intermediate regional flood.

Flooding of Spring Valley Creek, San Diego County, California is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06824

FLOOD PLAIN INFORMATION OF SENECA LAKE, NEW YORK.
Corps of Engineers, Buffalo, N. Y.

Corps Eng Flood Plain Rep, June 1967. 29 p, 6 fig, 3 plate, 3 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Seneca Lake (NY), Standard project flood, Intermediate regional flood.

Flooding of the Seneca Lake area, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06825

FLOOD PLAIN INFORMATION, CAYUGA LAKE, NEW YORK.
Corps of Engineers, Buffalo, N. Y.

Corps Eng Flood Plain Rep, June 1967. 29 p, 8 fig, 6 plate, 3 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Cayuga Lake (NY), Standard project flood, Intermediate regional flood.

Flooding of Cayuga Lake area, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06826

FLOOD PLAIN INFORMATION, CANANDAIGUA LAKE, NEW YORK.
Corps of Engineers, Buffalo, N. Y.

Corps Eng Flood Plain Rep, May 1967. 22 p, 7 fig, 2 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Canandaigua Lake (NY), Standard project flood, Intermediate regional flood.

Flooding of the Canandaigua Lake area, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-06827

4B. Groundwater Management

SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
San Bernardino Valley Municipal Water District, Calif.; and TRW Systems Group, Redondo Beach, Calif.
For primary bibliographic entry see Field 06A.
W69-06424

GROUND WATER, GRAVITY AND RIFT VALLEYS IN MALAWI,
Southern Illinois Univ., Carbondale. Dept. of Geology.
For primary bibliographic entry see Field 02F.
W69-06431

RURAL WATER DEVELOPMENT IN KENYA,
Department of Water Development (Kenya).
For primary bibliographic entry see Field 04A.
W69-06453

CONSTRUCTION AND MANAGEMENT OF RIVER VALLEY PROJECTS IN INDIA,
Ministry of Irrigation and Power (India).
For primary bibliographic entry see Field 04A.
W69-06457

IRRIGATION WATER SYSTEM--ISRAEL'S NATIONAL WATER GRID,
Water Planning for Israel Ltd., Haifa.
For primary bibliographic entry see Field 03F.
W69-06459

ARTIFICIAL RECHARGE TO THE EDWARDS LIMESTONE AQUIFER IN SOUTH TEXAS,
Corps of Engineers, Fort Worth, Tex.
Melvin G. Green.
Hydrol of fractured rocks, Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 465-481, 1967. 18 p, 5 fig, 13 ref.

Descriptors: *Artificial recharge, *Aquifer, *Limestones, *Texas, Water storage, Underground storage, Water supply, Faults, Water wells, Springs, Hydrologic properties, Floods, Rivers, Geology, Dams, Groundwater recharge, Water loss, Water balance, Water requirement, Water level fluctuations.
Identifiers: *Balcones fault zone, Edwards Limestone.

Because of critical water conditions in South Texas, the Fort Worth District of USCE, in cooperation with State agencies, investigated the feasibility of providing recharge to the Edwards Limestone aquifer as a flood control and water conservation measure. A proposed plan is presented. The study consisted of (1) a survey of available water for recharge and the problem of open-water evaporation; (2) the determination of maximum infiltration rates along the streams, (3) a further development of the hydrology and geology of the Edwards Limestone; (4) utilization of radioactive tracers; (5) fluctuation of the 'bad-water' line; (6) methods to control springflows; (7) feasibility of reducing leakage from an existing reservoir located in the Balcones fault zone; and (8) geologic investigation of ten damsites. The study shows that the construction of five dams (three dams to be considered primarily for recharge, flood control, and recreation) should be considered as highly desirable. Two other water-conservation dams would provide an additional 89,000 acre-feet annually. It is estimated that the proposed plan of improvement will meet all the water demands in the area to about the year 2000, beyond which better use of return flows and development of additional water supplies outside the Edwards Reservoir area will be needed. (Gabriel-USGS)
W69-06483

ARTIFICIAL RECHARGE OF A FISSURED SANDSTONE AQUIFER, TANGIERS, MOROCCO (FRENCH),
Robert Ambroggi, and Raymond Hazan.
Hydrol of fractured rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 496-499, 1967. 4 p.

Descriptors: *Artificial recharge, *Hydrologic properties, *Sandstones, *Fissures, Karst, Permeability, Geology, Water sources, Water quality, Water levels, Basins, Water yield, Water wells, Pumping, Tertiary, Economics.
Identifiers: *Morocco, City of Tangiers.

The article describes the history of water-supply development of the City of Tangiers, Morocco, and tells about a method of artificial rechrge. Geologic and hydrologic characteristics of the aquifers supplying the city are also described. The recharge of water consisted of taking it from the 'merias' in the center of the basin and secondly by diverting water in winter from a neighboring 'oued'. The method of recharge was by feeding the water into eight 10x5x2.5 m absorption basins in isotropic sandstones and into two pits excavated along a natural fault. The city in this way obtained a water supply of 720 cu m/hr by utilizing the fissures and karstification of sandstone and limestone aquifers. (Gabriel-USGS)
W69-06487

DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
Agricultural Research Service, Washington, D. C.
Soil and Water Research Div.; and South Dakota State Univ., Brookings. Remote Sensing Inst.
For primary bibliographic entry see Field 02G.
W69-06512

GEORGE V STATE (OBSTRUCTION OF SUBSURFACE FLOW).
For primary bibliographic entry see Field 06E.
W69-06590

ROLE OF GROUND WATER CONTAMINATION IN WATER MANAGMENT,
Geological Survey, Raleigh, N. C.
For primary bibliographic entry see Field 05G.
W69-06762

EFFECT OF SUBSIDENCE ON WELL FIELDS,
Santa Clara Valley Water Conservation District, San Jose, Calif.
J. Robert Roll.
Am Water Works Assoc Jour, Vol 59, No 1, pp 80-88, Jan 1967. 4 fig, 1 ref.

Descriptors: *Subsidence, *Wells, *Damages, *Pumping, *Overdraft, California, Groundwater basins, Faults (Geology), Valleys, Bedrock, Aquifers, Dams, Water demand, Water conservation, Water delivery, Drainage systems, Percolation, Groundwater recharge.
Identifiers: *Santa Clara Valley, California.

In the Santa Clara Valley, California, subsidence has resulted from overpumping of the groundwater basin, causing serious damage to wells. Bounded by the Hayward Calaveras, and San Andreas faults, the long valley floor is underlain by consolidated bedrock beneath the semiconsolidated Santa Clara formation, which may yield a little water to penetrating wells. Recent alluvium up to 1,000 feet thick is the principal aquifer. Conservation programs included dams for storing flood waters to percolate more slowly into the basin; canals, pipelines, and percolation basins; and imported water. Maximum subsidence is 9 feet at San Jose, in a trough corresponding with the area of confined ground water, affected the gradient of drainage structures crossing it, stream transport, and deposition and flooding. The only permanent solution to the problem is to raise the ground-water level. (Affleck-Ariz)
W69-06763

THE GROUNDWATER PROVINCES OF IRAN,
Hebrew Univ., Jerusalem (Israel); Geological Survey of Israel, Jerusalem; and Center for Groundwater Research, Jerusalem (Israel).
A. Issar.
Bull Int Ass Sci Hydrol, Vol 14, No 1, pp 87-99, Mar 1969. 13 p, 5 fig, 2 tab, 12 ref.

Descriptors: *Hydrogeology, *Groundwater, Aquifers, Geohydrologic units, Geologic control, Climates, Groundwater basins, Structural geology, Alluvium, Springs.

Identifiers: *Iran, Caspian Coastal Plain, Alborz Mountains, Zagros Mountains, Central Plateau.

The hydrogeology of Iran is outlined. The influences of climate, lithology, and geological structure on the occurrence, flow, and quality of groundwater in the Central Plateau, the Zagros Mountains, the Caspian Coastal Plain, and the Alborz Mountains are described. The main aquifer in the Central Plateau is thick Pleistocene alluvium, recharged mainly by floods of mountain streams. In the Zagros Mountains, permeable limestones folded into hundreds of anticlines and synclines form many artesian systems. Basin-fill alluvium aquifers are an important secondary water source. The Caspian Coastal Plain is humid and underlain by seaward sloping alternating pervious and impervious beds, forming a productive artesian system. The Alborz Mountains are complexly folded and faulted. The northern end of the range is humid, and the southern end is arid. Faulting and the impermeability of most of the rocks at the central and western parts of the range are reasons for the lack of important aquifer systems. In the eastern part of the range limestones of Jurassic and Cretaceous age are important regional aquifers. (Knapp-USGS)
W69-06772

CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Irrigation Engineering; and Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 03F.
W69-06796

4C. Effects on Water of Man's Non-Water Activities

WATER RESOURCES AND THE URBAN ENVIRONMENT,
Virginia Polytechnic Inst., Blacksburg.
James E. Hackett.
Ground Water, Vol 7, No 2, pp 11-14, Mar-Apr 1969. 4 p, 5 ref.

Descriptors: *Water management (Applied), *Urbanization, *Water resources development, Administration, Water reuse, Water sources, Waste disposal, Water pollution control, Multiple-purpose projects, Recreation, Planning, Political aspects.
Identifiers: *Urban water use.

Approximately 2/3 of the present population live in the urban environment; by the year 2000, it is anticipated that 5/6 of the population will be urban. The trend of metropolitan growth is the expansion in population and size of the smaller suburban communities. In some areas of intense urban development the problems of water quality control, recreational use of water, and water for cooling and waste transport have become more significant than problems of adequate supplies for withdrawal. The use of surface-water sources far removed from the urban center has contributed to the development of the 'commodity concept' of water use. By this attitude the water resource is viewed only in terms of its adequacy as a water supply; waste discharge and recreation uses are ignored or considered a 'downstream' problem. This concept is particularly inappropriate when applied in the multicommunity complexes of the metropolitan areas where there is little in the way of a 'downstream'. Water problems must be dealt with at the metropolitan level rather than at the individual community level, and not by the proliferation of smaller units of government. The nature of the metropolitan complex requires thinking in terms of closed systems involving reclamation and reuse rather than in terms of the open system of withdrawal, use and discharge. (Knapp-USGS)
W69-06428

FLOOD INUNDATION AND EFFECTS OF URBANIZATION IN METROPOLITAN CHARLOTTE, NORTH CAROLINA,
Geological Survey, Washington, D. C.
Lawrence A. Martens.
Geol Surv Water-Supply Pap 1591-C, 1968. 60 p, 24 fig, 2 plate, 12 tab, 6 ref.

Descriptors: *Floods, *Urbanization, *Stage-discharge relations, *North Carolina, Drainage systems, Land use, Storm runoff, Runoff, Rainfall-runoff relationships, Hydrographs, Hydrologic data, Discharge (Water).
Identifiers: Charlotte (NC), Flood profiles.

Investigation of floods on 7 streams in metropolitan Charlotte, N. C., indicates that significant increases in flood potential accompany urban development of the basins. Rainfall excess increases with the development of urban areas which are more impervious than rural areas. The magnitude of the mean annual flow increases with an increase in the degree in imperviousness. The effect of impervious area diminished with increased flood recurrence intervals becoming negligible for floods exceeding 50 yr. Basin lag time for fully developed basins was found to be about one-fourth the lag time before development. The increase in impervious area and decrease in lag time associated with the urbanization of a basin will about double the discharge of a 20-yr flood. Computed flood elevations of the 20-yr flood along 60 mi of stream channels reflect increases in elevation of as much as 6 ft for some areas as a direct result of extensive watershed development. In other areas, where channel and flood-plain improvements have been made, the increase in elevation of the 20-yr flood is as small as 1 ft. Seventy-five % of the channels in metropolitan Charlotte will reflect an increase of about 3 1/2 ft in the elevations of the 20-yr flood as a result of the change in the basins from undeveloped to urbanized conditions. Studies to determine the feasibility of selecting cross-section properties directly from detailed topographic maps, when computing flood profiles, indicate that about a 0.3 ft error can be expected in profile elevations of floods at about bankful stage; a lesser error can be expected in profile elevations of floods above bankful stage. (Knapp-USGS)
W69-06445

BARBER PURE MILK CO V GOLDIN (SURFACE DRAINAGE).
For primary bibliographic entry see Field 06E.
W69-06588

IOWA-WISCONSIN BRIDGE CO V UNITED STATES (LIABILITY FOR RESERVOIR OPERATION).
For primary bibliographic entry see Field 06E.
W69-06604

GIBSON V STATE (CONSTRUCTION AND MAINTENANCE OF SEWERS).
For primary bibliographic entry see Field 06E.
W69-06607

AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
American Society of Civil Engineers, Cambridge, Mass. Urban Hydrology Research Council.
M. B. McPherson, D. C. Taylor, and L. S. Tucker.
Amer Soc Civil Eng Basic Inform Rep, Apr 1969. 112 p, 14 fig, 4 tab, 73 ref.

Descriptors: *Rainfall-runoff relationships, *Urbanization, Drainage Systems, Instrumentation, Hydrologyic data, Measurement, Networks, Meteorological data, Surveys, Data processing.
Identifiers: *Data needs, *Urban Hydrology.

An Analysis of National Basic Information Needs in Urban Hydrology is focused on data needs, data devices and data networks. Primarily aimed at improvement in design of storm drainage, intensive study was made of the data requirements for analyzing rainfall-runoff-quality relationships and of suitable data collection instrumentation, with consideration of the types of networks required for the collection of adequate data. Suitable data collected with properly coordinated instrumentation in networks representing a variety of climatic, topographic and land-use conditions, are virtually non-existent. There are very meager amounts of performance data with which existing or proposed storm drainage facilities can be checked or designed. Transfer of data findings between metropolitan regions is a central and primary objective. Recommendations centered on hydrologic information needs are related to storm sewers. The replacement value of existing storm sewerage systems in the United States is at least $22 billion, and it is estimated that an average of about $3.5 billion per year will be spent on construction of new storm sewerage systems over the next several years. The plan recommended for a minimum national program of urban storm drainage research would cost on the order of 1/3% of this average annual construction cost. (Knapp-USGS)
W69-06770

4D. Watershed Protection

USE OF TRACER TECHNIQUE IN SOIL EROSION RESEARCH,
Agricultural Research Service, Oxford, Miss.
J. Roger, McHenry.
Trans Amer Soc Agr Eng, Vol 11, No 5, pp 619-625, Sept-Oct 1968. 7 p, 2 fig, 2 tab, 31 ref.

Descriptors: *Tracers, *Radioisotopes, *Soil erosion, Tagging, Alpha rays, Tritium, Beta rays, Gamma rays, Bibliographies, Sampling, Half life, Radioactivity, Research equipment, Radiation measurement, Soil science, *Erosion.
Identifiers: Scintillation counters.

A review is given for those considering the use of radioactive tracers in soil erosion research. The selection and characteristics of a tracer, including half life, specific activity, type of emission, and chemical and physical form are discussed. The method for calculating the required amount of the tracer is described; the general theory of using tagged particles as tracers and of isotopic dilution is given. Selecting and preparing a radioisotope, and tagging and seeding particles in the experimental area are described. Methods are outlined for detection, sample counting, and data reduction. Advantages and disadvantages are presented for using radioisotopes as tracers. In erosion research, the measurement of volume movement of a soil mass is difficult to evaluate. If the entire soil mass can be traced or if the tracer can be mixed uniformly in the system samples, quantitative results can be calculated. These conditions do not usually occur and the result is that tracer data are more qualitative than quantitative. (USBR)
W69-06704

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-III. A STUDY OF PHENOL CONTENT IN SURFACE WATERS,
Rutgers - The State Univ., New Brunswick, N. J. Dept. of Environmental Sciences; and Geological Survey, Washington, D. C.
Samuel D. Faust, and Peter W. Anderson.
Water Res, Vol 2, pp 515-525, 1968. 11 p, 2 fig, 3 tab, 10 ref. OWRR Proj No A-012-NJ.

Descriptors: *Water chemistry, *Analysical techniques, *Phenols, *Colorimetry, *Surface

waters, Water pollution sources, Pollutant identification, Indicators, Water pollution.
Identifiers: Phenol detection.

Surface waters may contain phenolic compounds. One of the more serious water-quality problems is the lack of specific and sensitive analytical techniques for the detection of these compounds. In order to test the applicability of an improved and modified 4-aminoantipyrine colorimetric procedure to natural waters, a program was undertaken to systematically sample 17 sites in 5 river systems of northeastern New Jersey, and to examine these samples for phenol. This reconnaissance survey revealed concentrations in excess of 1.0 micrograms/l which is the 'recommended potable water-quality standard' established by the New Jersey State Department of Health. All samples were split in order to compare results obtained by the Standard Methods procedure (Method I) to those obtained by the modified procedure (Method II). In 84 of 153 split samples, Method II yielded higher results than Method I. In addition, 44 of these 84 samples were cases in which Method II obtained higher results than the analytical sensitivity of Method I. This increased sensitivity is viewed as an advantage for Method II and an improvement over the Standard Methods. The phenol concentrations found in the 153 samples ranged from less than the analytical sensitivities of Methods I and II to the highest observed concentration of 210 micrograms/1. (Knapp-USGS)
W69-06444

NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
Washington Univ., Seattle. Lab. of Radiation Ecology.
T. M. Beasley, and E. E. Held.
Science, Vol 164, No 3884, pp 1161-1163, June 6, 1969. 3 p, 2 tab, 1 fig, 14 ref.

Descriptors: *Radioecology, *Radioactivity techniques, *Biota, *Pacific Ocean, Marine animals, Environmental effects, Sediments, Lichens, Clams, Lagoons, Atolls, Radiation.
Identifiers: *Radionuclides, *Nickel-63, Terrestrial biota, Marine currents.

A previously unreported radionuclide, nickel-63 (half-life, 92 yr), produced in the testing of nuclear devices, was measured in biological and environmental samples from areas of the Pacific Ocean and the eastern seaboard of the United States. Data are presented showing concentration of nickel-63 in several environmental samples in 8 areas and specific activities of the radionuclide in clams from 4 areas. Nickel-63 concentrations are low (maximum of 163 disintegrations per minute per gram of dry weight), but this radionuclide may be a useful tracer of oceanic processes because of its long half-life and long residence time in lagoons, atolls, and the ocean. (Land-USGS)
W69-06766

5B. Sources of Pollution

MICROBIAL PROBLEMS IN GROUNDWATER,
National Water Supply Research Lab., Washington, D. C.
For primary bibliographic entry see Field 05C.
W69-06426

WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
Water Resources Engineers, Inc., Lafayette, Calif.; and California Univ., Berkeley.
For primary bibliographic entry see Field 05G.
W69-06499

STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
Virginia Polytechnic Inst., Blacksburg, Va.
Richard P. Thayer, and Richard G. Krutchkoff.
Proc, Amer Soc Civil Eng, Vol 93, No SA3, pp 59-72, June 1967. 14 p, 5 fig, 2 tab, 4 ref, 1 append.

Descriptors: *Mathematical models, *Water quality control, *Oxygen sag, Time of concentration, Streamflow, Hydrologic data, River systems, Water pollution effects, Dissolved oxygen, Standards.
Identifiers: Sacramento River.

A stochastic model for pollution and dissolved oxygen in steams was presented. Given the steam parameters and the initial conditions, the model predicted the mean amounts of pollution and dissolved oxygen at any point downstream, and also their variability with time. The proportion of time that pollution was above, or DO was below, any given concentration, could be determined. The theoretical results were tested by comparing them with controlled laboratory experiments and with data from the Sacramento River. It was observed that the means of both pollution and dissolved oxygen followed equations obtained by Dobbins in an earlier paper. It was concluded that the greatest variability in DO occurred at the sag, where it was most critical. (Gysi-Cornell)
W69-06500

ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
New York State Dept. of Health, Albany. Div. of Laboratories and Research.
William W. Ullmann, Robert W. Schaefer, and Wallace W. Sanderson.
J Water Pollution Control Fed, Vol 33, No 4, pp 416-418, April 1961. 1 tab, 5 ref.

Descriptors: *Aquatic weed control, *Arsenic compounds, *Fish, *Herbicides, *Lakes, *Sodium arsenite, Aquatic plants, Chemical analysis, Drainage effects, Neutron activation analysis, New York, Sediments, Water chemistry, Alkalinity.
Identifiers: Calico bass, Cassadaga Lake (NY), Chautauqua Lake (NY), Findley Lake (NY).

Authors investigated concentrations of arsenic in water and fishes (calico bass) in three New York State lakes, two of which had been subjected to sodium arsenite treatment for submerged plants. Analytical methods for lake water were not described, but residues in fish were determined by neutron activation analysis. Findley Lake (alkalinity: 56 milligram/liter) contained arsenic concentration of 0.06 milligrams/liter before spraying, 7.0 milligrams/liter immediately after spraying in May 1958, and 1.5 milligrams/liter one week later. By spring 1959, concentration had returned to pretreatment level. Chautaugua Lake (alkalinity: 256 milligrams/liter) contained 0.01 milligrams/liter before treatment in June 1959. After application of arsenical (4.5 hours), concentration of 0.45 milligrams/liter was found, which diminished to 0.04 milligrams/liter after 11 days. Untreated Cassadaga Lake (alkalinity: 64 milligrams/liter) contained arsenic concentrations from 0.04 to 0.10 milligrams/liter during year preceding study. In Cassadaga and Chatauqua Lakes mean arsenic residue was lower than detectable limit (0.10 micrograms/gram net weight). Authors attribute higher residues in Findley Lake fish (means: 0.28-056; maxima: 0.31-1.0) to persistence of residual arsenic here. In all fish examined, arsenic was less than that reported by others for edible marine fish. (Eichhorn-Wis)
W69-06541

NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
Washington Univ., Seattle. Lab. of Radiation Ecology.
For primary bibliographic entry see Field 05A.
W69-06766

DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
Geological Survey, Washington, D. C.
R. J. Pickering.
Geol Surv Prof Pap No 433-H, pp H1-H25, 1969. 25 p, 7 fig, 10 tab, 46 ref.

Descriptors: *Sediment transport, *Path of pollutants, *Radioisotopes, *Radioactive waste disposal, *Tennessee, Radioactive wastes, Bed load, Cobalt radioisotopes, Water pollution sources, Clays, Ion exchange, Sediments, Suspended load, Alluvium.
Identifiers: *Radioactive sediment transport, Clinch River (Tenn), Cesium radioisotopes.

Radioactive bottom sediment in the Clinch River in eastern Tennessee was investigated through a study of the distribution of radioactivity in sediment cores taken from a 21-mile-long reach of river downstream from Oak Ridge National Laboratory. Low-level-radioactive liquid wastes are released from the Laboratory to the Clinch River via Whiteoak Creek. In the upper 8 mi of the reach, radioactive sediment is found only along the sides of the stream channel, but in the lower 13 mi of the river, it extends out into the main part of the channel as well and attains its greatest thicknesses. Several sediment cores from the lower part of the river showed the same general pattern of variation of gross gamma radioactivity with depth. This pattern resembled the pattern of annual releases of cesium-137 from the Oak Ridge National Laboratory. Statistical comparison of the patterns confirmed the similarity. It is concluded that cesium-137 and cobalt-60 were incorporated in Clinch River bottom sediment by deposition of suspended radioactive solids which entered the river from Whiteoak Creek. Cation-exchange properties of the sediment are controlled largely by its content of mica and clay minerals. The effects of chemical and physical properties of the sediment on its radionuclide content are obscured as a result of variations in annual releases of the radionuclides and as a result of dilution of radioactive sediment by nonradioactive sediment in the river. Compositional effects were descernible only after corrections were made for variations in annual releases of radionuclides. (Knapp-USGS)
W69-06785

OIL AND HAZARDOUS MATERIALS-EMERGENCY PROCEDURES IN THE WATER ENVIRONMENT.
Federal Water Pollution Control Administration, Edison, N. J. North Atlantic Water Quality Management Center.
For primary bibliographic entry see Field 05G.
W69-06791

POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
Federal Water Pollution Control Administration, Washington, D. C.
Murray Stein.
Proc 2nd Sess of Conf on Pollut of Interstate Waters, Mass and Rhode Island, May 28, 1968, Providence, 1968. 166 p, 1 fig, 4 tab.

Descriptors: *Water pollution, *Water pollution control, *Water pollution treatment, *Pollution abatement, *Massachusetts, *Rhode Island, Water quality act, Water quality control, Water quality.
Identifiers: FWPCA Water-pollution conference.

Proceedings of a water pollution conference on the waters of the Blackstone and Ten Mile Rivers and their tributaries, Mass and R.I., are compiled. The purpose of the conference was to bring together State and interstate water pollution control agencies, representatives of the U. S. Department of the Interior and other interested parties to review the existing situation and the progress which has been made, to lay a basis of future action by all parties concerned and to give the States, localities, and industries an opportunity to take any indicated remedial action under State and local law. (Knapp-USGS)
W69-06802

5C. Effects of Pollution

EFFECTS OF MINE DRAINAGE ON GROUND WATER,
Pennsylvania Dept. of Health, Harrisburg; and West Virginia Univ., Morgantown.
Grover H. Emrich, and Gary L. Merritt.
Ground Water, Vol 7, No 3, pp 27-32, May-June 1969. 6 p, 8 fig, 2 tab.

Descriptors: *Water pollution, *Groundwater, *Acid mine water, *Pennsylvania, Groundwater movement, Recharge, Surface-groundwater relationships, Sulfates, Hydrogen ion concentration, Appalachian Mountain Region, Path of pollutants, Iron.
Identifiers: *Ground-water pollution, Toms Run (Pa).

Results of a study are presented which show that coal mining in Appalachia has degraded both the surface and groundwater. During mining, the pyrite associated with the coal beds is exposed to air. Oxidation and leaching of the phrite produces high iron and sulfate concentration and low pH in groundwater and surface waters. Iron concentration can increase up to several hundred mg/1 and the sulfates to over one thousand mg/1. Unfortunately, in most cases the cessation of mining does not stop the groundwater pollution, and it can take many decades before the groundwater again becomes usable. In the Toms Run drainage basin, northwestern Pennsylvania, coal mining and oil and gas well drilling have gone on for almost 100 years. The rocks of Mississippian and Pennsylvanian Age contain a multiaquifer system. Three major aquifers are separated by siltstone and shale aquitards. The oil and gas wells and the natural joints and fractures in the rocks act as conduit systems permitting acid mine drainage to move downward from the strip mines and into underlying aquifers. The mine drainage adversely affects the groundwater quality by increasing the iron and sulfate content of the water especially in the vicinity of the strip mines. (Knapp-USGS)
W69-06425

MICROBIAL PROBLEMS IN GROUNDWATER,
National Water Supply Research Lab., Washington, D. C.
Gordon G. Robeck.
Ground Water, Vol 7, No 3, pp 33-35, May-June 1969. 3 p, 8 ref.

Descriptors: *Water pollution, *Groundwater, Diseases, Water pollution effects, Coliforms, Salmonella, Viruses, Public health, Epidemiology.
Identifiers: *Groundwater contamination.

Disease outbreaks caused by contaminated groundwater and problems of controlling and monitoring groundwater quality are discussed. Recharge of large groundwater basins with reclaimed sewage can cause microbial contamination. Coliforms, the usual indicators of contamination, are not always useful. Salmonella outbreaks have occurred without any detectible coliforms, and coliforms are filtered out of water by many media that will pass virus particles. Nitrates in waste water are difficult to remove and dangerous to health. Chlorination of all groundwater for domestic use is recommended as good insurance for microbial control. (Knapp-USGS)
W69-06426

STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
Virginia Polytechnic Inst., Blacksburg, Va.
For primary bibliographic entry see Field 05B.
W69-06500

A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab; and Food and Agriculture Organization of the United Nations, Rome (Italy). Fisheries Biology Branch.
R. J. H. Beverton, and S. J. Holt.
Ciba Found Symp, Lifespan of Animals, Vol 5, pp 142-177, 1959. 1 tab, 8 fig, 106 ref.

Descriptors: *Fish, *Growth rates, *Mortality, Fisheries, Fish physiology.
Identifiers: *Lifespans, *Mortality rates, *von Bertalanffy curves, Asymptotic length, Metabolic rate.

Effective strategies for management of fish populations require information on longevity and force of mortality. Data on 69 species of fish are compared in terms of von Bertalanffy parameters, natural mortality coefficients, maximum age, and length at maturity. Comparisons are made of maximum age, mortality rate, asymptotic length, and growth rate, indicating direct relationships between growth rate and mortality rate. Maximum age and asymptotic length are closely correlated, and inverse correlations occur for maximum age-mortality rate and asymptotic length-growth rate comparisons. Comparisons with environmental data indicate that growth rate is affected by temperature and that asymptotic length is affected by food and temperature. Growth rate varies with log temperature and is closely related to metabolic rate and activity. Comparisons of the ratio (length at maturity:asymptotic length) with maximum age suggest that high ratios are related to short lifespans. 'Reproductive drain' appears to occur in species showing high growth rates, early maturity, and high length at maturity:asymptotic length ratios. (Voigtlander-Wis)
W69-06533

THE AGING OF LAKES,
Wisconsin Univ., Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 02H.
W69-06535

SIMULATION OF AN AQUATIC ECOSYSTEM,
Washington State Univ., Pullman. Dept. of Zoology; and Washington State Univ., Pullman. Dept. of Information Science.
For primary bibliographic entry see Field 02H.
W69-06536

THE DESIRABILITY AND APPLICABILITY OF SIMULATING ECOSYSTEMS,
Battelle Memorial Inst., Columbus, Ohio.
For primary bibliographic entry see Field 06A.
W69-06537

THE WORK OF THE FRESHWATER BIOLOGICAL ASSOCIATION OF GREAT BRITAIN IN REGARD TO WATER SUPPLIES. (a) THE NITROGEN BALANCE OF LARGE QUANTITIES OF WATER,
For primary bibliographic entry see Field 02K.
W69-06538

APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
Cornell Univ., Ithaca, N. Y. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W69-06540

SPECIES DIVERSITY AND COMMUNITY STRUCTURE IN LACUSTRINE PHYTOPLANKTON,
Wisconsin Univ., Madison. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W69-06542

POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
Federal Water Pollution Control Administration, Washington, D. C.
For primary bibliographic entry see Field 05B.
W69-06802

5D. Waste Treatment Processes

STREAM POLLUTION CONTROL IN THE UPPER CUMBERLAND RIVER BASIN-1965.
Tennessee Dept. of Public Health, Nashville. Stream Pollution Control Div.
For primary bibliographic entry see Field 05G.
W69-06488

ECONOMIC FRAMEWORK FOR SALINITY CONTROL PROJECTS,
Harvard Univ., Cambridge, Mass.; and Colorado River Basin Project, Denver.
Philip J. Coffey, and Leonard Ortolano.
J Amer Water Works Ass, Vol 61, No 5, pp 237-241, May 1969. 5 p, 2 fig, 2 tab, 16 ref.

Descriptors: *Salinity, *Water pollution control, *Economic justification, Cost-benefit analysis, Mathematical models, Marginal benefits, Marginal costs, Dissolved solids, Water users, River flow, Optimum development plans, Water management (Applied).
Identifiers: Differential equations, Graphical methods.

A systematic approach for finding the optimal level and type of salinity control on a river was presented, and a hypothetical example demonstrated its use. The objective was to determine the minimum total pollution cost, which was the sum of upstream control costs (a decreasing function of downstream residual salinity), and downstream users costs, (an increasing function of salinity). Differential equations of cost as a function of total dissolved solids were derived and solved. The necessary first and second order conditions for cost minimization or benefit maximization were obtained. A graphical method was presented which extrapolated between four possible treatment levels. The method can be applied in situations where the level of water-use is static. (Gysi-Cornell)
W69-06490

SLUDGE DISPOSAL ALTERNATIVES -- SOCIO-ECONOMIC CONSIDERATIONS,
Washington Univ., Seattle.
For primary bibliographic entry see Field 05E.
W69-06492

WATER QUALITY MANAGEMENT: ENGINEERING-ECONOMIC FACTORS IN MUNICIPAL WASTE DISPOSAL,
California Univ., Berkeley.
Richard J. Frankel.
Water Resources Res, Vol 1, No 2, pp 173-186, 2nd Quarter, 1965. 14 p, 5 fig, 8 tab, 8 ref.

Descriptors: *Water management (Applied), *Water quality control, *Computor models, Waste water treatment, Municipal water, Stream improvement, Alternative costs, Water treatment, Hydrologic data, Oxygen sag.
Identifiers: Eel River (Calif).

The results of a river basin computer study, which determined the savings of downstream treatment cost resulting from incremental upstream waste treatment, were presented. Hydrologic data from the Eel River in California were incorporated in the dynamic oxygen sag model developed. Principle variables of the model were original streamflow quantity and quality, hydraulic and physiographic characteristics of the stream, degree of stream self-purification, treatment level, distance and required use between communities, and water treatment

level at the downstream community. It was concluded that maximal return per additional investment dollar is from primary to secondary sewage treatment (cost-savings ratios from negligible to 0.10). The quantity of withdrawal of municipal water supply required to justify upstream treatment varies from 16 to 250:1 for small sewage plants to 10 to 30:1 for large plants, if in-place stream quality is unimportant. (Gysi-Cornell)
W69-06505

WATER SUPPLY AND WASTEWATER TREATMENT PROBLEMS OF INDUSTRIAL AND TRADE ENTERPRISES,
W. Husmann.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, Washington, D C, U S Government Printing Office, pp 29-34, 1968. 6 p.

Descriptors: *Waste treatment, *Pollution abatement, *Water supply, Water management, Public health, Industrial wastes, Chemical wastes, Sewage, Recirculated water, Detergents, Sludge, Biological treatment.
Identifiers: *Federal Republic of Germany, *Emscher Association, Economic development, Rhine River.

A look at the present-day position of industrial wastewater treatment will reveal that for all branches of industry and also the chemical industry, efficient treatment plants have been, and still are being developed in growing number which will serve their purpose and ensure adequate biological and mechanical treatment. In the Federal Republic of Germany the Emscher (Basin) Association, in order to protect the population from damage and nuisance caused by domestic and industrial wastes, sees to it that surface depressions due to coal mining operations are promptly made up for and wastes quickly run off and treated in association-owned treatment plants. Apart from wastewater treatment within the Emscher Basin itself all essential treatment measures must aim at keeping clean, and reducing the load imposed on the Rhine. The Emscher Association demands of all polluters of the Emscher or its tributaries to cool down, treat, and neutralize all wastes prior to their discharge to such a degree that they do not constitute a threat to sound hygenic conditions, do not cause offensive smells or odors, and do not damage or endanger the operation of treatment plant components. (Sokoloff-Rutgers)
W69-06723

22 ND INDUSTRIAL WASTE CONFERENCE, 1967, PART ONE,
Purdue Univ., Lafayette, Ind. School of Engineering; and Purdue Univ., Lafayette, Ind. Div. of Conferences and Continuation Services.
Don E. Bloodgood.
Purdue Univ Eng. Ext Ser no 129, Proc 22nd Ind Waste Conf, May 2-4, 1967, Lafayette, Indiana, 1967. 552 p, 257 fig, 111 tab, 454 ref.

Descriptors: *Industrial wastes, *Water reuse, *Waste treatment, Waste indentification, Water pollution treatment, Reaeration, Waste disposal, Wastewater disposal, Injection wells, Water chemistry, Dissolved oxygen.
Identifiers: *Industrial Waste Conference.

The 22nd annual Industrial waste Conference, Purdue University, 1967 discussed means of treating industrial wastes, industrial reuse of municipal and industrial waste water, and water pollution treatment in streams. Recovery of materials from wastes and indentification of waste materials were also discussed. Contains 85 papers. (Knapp-USGS)
W69-06821

RECLAIMED WASTE WATER IN LAS VEGAS VALLEY,
Nevada Univ., Reno. Dept. of Civil Engineering; and Nevada Univ., Reno. Desert Research Inst.
R. G. Orcutt.
Desert Res Inst, Nev Univ Coll Eng Rep No 2, Aug 1965. 122 p, 10 fig, 22 tab, 75 ref, 4 append.

Descriptors: *Water reuse, *Tertiary treatment, *Nevada, Sewage treatment, Artificial recharge, Aquifers, Irrigation water, Water demand, Reclaimed water, Salvage value, Water utilization, Water yield, Water supply, Arid lands, Nevada.
Identifiers: *Las Vegas Valley (Nev).

Sewage collection, treatment, disposal, and the reuse of treated effluents in Las Vegas Valley, Nevada, were studied. The demand for effluent in the vicinity of the existing sewage treatment plant sites is expected to be substantially less than the planned capacities of the plants at these sites. Large amounts of storage will be required to utilize the excess effluent which would result from the seasonal variations in the existing and expected future reuse of reclaimed water. It will be necessary to recharge productive aquifers with reclaimed water if the water is to be reclaimed at minimum unit cost. There were insufficient data available to permit the evaluation of the feasibility of groundwater recharge. Waste water reclamation plants located higher in the sewage collection system appear to offer the best opportunity for economical utilization of reclaimed water. These plants should be located in areas which would permit maximum direct reuse of reclaimed water and which would allow a maximum credit, for the relief of downstream sewerage facilities, to be applied to the cost of the reclamation plan. Ideally, these plants would use trunk sewers as a source of raw water supply and for the disposal of solid wastes. More information relative to sewage flows and the use of water for irrigation in Las Vegas Valley is needed in order that the optimum waste water reclamation plan can be developed. (Knapp-USGS)
W69-06832

5E. Ultimate Disposal of Wastes

SLUDGE DISPOSAL ALTERNATIVES -- SOCIO-ECONOMIC CONSIDERATIONS,
Washington Univ., Seattle.
Brian W. Mar.
J Water Pollut Contr Fed, Vol 41, No 4, pp 547-552, Apr 1969. 6 p, 2 fig, 11 ref.

Descriptors: *Sludge disposal, *Alternative costs, *Social values, *Economics, Social needs, Systems analysis, Environmental engineering, Environmental sanitation, Constraints, Waste treatment.
Identifiers: *Socio-economic considerations, Muddling, Feedback.

The 'socio-economic' problem of sludge disposal was presented and discussed. It was established that no technical barrier to the problem exists, with almost any form of removal being obtainable for under $50 per ton, but that the 'muddling' technique now used in large urban systems for incrementally solving piecemeal environmental problems, hampered by poor information feedback within the system, is hampering overall system optimization solutions. Systems analysis techniques could be used to solve the overall problems but as yet quantified values have not been established for many of the social benefits and costs of environmental controls. However, it was concluded that social benefits of environment quality maintenance are likely of such a magnitude that the maximum degree of treatment should be used. A possible environmental damage charge compensation payment fund was alternatively suggested as a method of welfare optimization. (Gysi-Cornell)
W69-06492

A HEURISTIC AID FOR THE DESIGN OF SEWER NETWORKS,
Cornell Univ., Ithaca, N. Y.
Jon C. Liebman.
Proc, Amer Soc Civil Eng, Vol 93, No SA4, pp 81-90, Aug 1967. 10 p, 8 fig, 2 ref.

Descriptors: *Network design, *Optimization, *Costs, *Digital computers, *Sewers cost comparisons, Cost analysis, Excavation.
Identifiers: Iterative search method.

An iterative search method, programmed for use on a digital computer, which sought improved layouts in gravity flow sewage collection networks, was presented. The method required an original node-link layout, selected by engineering judgement, and an iterative search for cost reducing adjustments. At each node an unused link was checked to see if costs could be reduced by replacing an existing link with a new one. If replacement reduced costs, the search began at the first node again. The program ended when no improvements could be found. No guarantee of an optimal solution was obtained, as illustrated by different original network selections for a hypothetical example. However, the same least cost solution was found for most original networks chosen. (Gysi-Cornell)
W69-06498

WATER QUALITY MANAGEMENT: ENGINEERING-ECONOMIC FACTORS IN MUNICIPAL WASTE DISPOSAL,
California Univ., Berkeley.
For primary bibliographic entry see Field 05D.
W69-06505

5F. Water Treatment and Quality Alteration

ECONOMIC FRAMEWORK FOR SALINITY CONTROL PROJECTS,
Harvard Univ., Cambridge, Mass.; and Colorado River Basin Project, Denver.
For primary bibliographic entry see Field 05D.
W69-06490

WATER QUALITY MANAGEMENT: ENGINEERING-ECONOMIC FACTORS IN MUNICIPAL WASTE DISPOSAL,
California Univ., Berkeley.
For primary bibliographic entry see Field 05D.
W69-06505

THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT: A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
Cornell Univ., Ithaca, N. Y.
Charles Revelle, Gary Dietrich, and David Stensel.
Water Resources Research, Vol 5, No 2, pp 507-513, April 1969. 7p, 1 fig, 4 tab, 3 ref.

Descriptors: *Water quality, *Linear programming, Constraints, Financial analysis, Dissolved oxygen, River basins, Efficiencies, River basin development, Biochemical oxygen demand, Oxygen sag.
Identifiers: *Financial constraint, *Water quality management, Dual variable.

Limited funds for building treatment facilities on a river basin are allocated to secure the largest possible value of the minimum level of dissolved oxygen. Linear programming is utilized to determine the configuration of efficiencies that achieve this goal. At optimality, the dual variable associated with the financial constraint indicates the instantaneous rate of change of the minimum dissolved oxygen concentration with respect to the funds available. Several alternative formulations of the problem are discussed and numerical example is solved to illustrate the methodology. (Loeb-Rutgers)
W69-06547

ECONOMIC EFFECTS OF MINERAL CONTENT IN MUNICIPAL WATER SUPPLIES.
Black and Veatch, Kansas City, Mo.
For primary bibliographic entry see Field 03A.
W69-06555

MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
Southwest Research Inst., Houston, Tex.; and Texas Water Development Board, Austin.
For primary bibliographic entry see Field 03A.
W69-06559

WATER POLLUTION CONTROL,
For primary bibliographic entry see Field 05G.
W69-06731

5G. Water Quality Control

STREAM POLLUTION CONTROL IN THE UPPER CUMBERLAND RIVER BASIN-1965.
Tennessee Dept. of Public Health, Nashville. Stream Pollution Control Div.

Tenn Stream Pollut Contr Board Publication, 1965. 37 p, 1 fig, 1 map, 9 tab.

Descriptors: *Water pollution control, *Tennessee, *Water pollution treatment, Waste treatment, Sewage treatment, Municipal wastes, Industrial wastes, Sewage disposal, Waste disposal.
Identifiers: Upper Cumberland River Basin.

The stream pollution abatement progress in the Upper Cumberland River Basin in the past 20 yr is outlined. Also included is a summarization of existing conditions and progress achieved in the Green River Basin. Since 1944, 13 new sewage treatment plants were built in the Upper Cumberland River Basin, and the sewered population increased 232% to a total 57,280, or 23% of the total population of the basin. In 1944, only 7% of the total population was sewered. In 1944, the organic wastes discharged from cities and industries in the Upper Cumberland River Basin had, before treatment, a population equivalent of 27,880. Due to expanding industrial operations and growing municipalities, this has increased 213% to 87,385 in 1965. The organic wastes being discharged, after treatment, into the Upper Cumberland River and its tributaries have increased only 20%. In 1944, a reduction of only 24% in the organic strength of the wastewater was achieved by all of the sewage treatment facilities. At present, a reduction of 71% is being achieved. Additional treatment now proposed will reduce the strength of the effluent still more, and where stream pollution problems exist, recommendations have been made to rectify the situations. (Knapp-USGS)
W69-06488

RESERVOIR MANAGEMENT: THE TRADEOFF BETWEEN LOW-FLOW REGULATION AND FLOOD CONTROL,
Federal Water Pollution Control Administration, Washington, D. C.
For primary bibliographic entry see Field 04A.
W69-06496

WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
Water Resources Engineers, Inc., Lafayette, Calif.; and California Univ., Berkeley.
Gerald T. Orlob, and Philip C. Woods.
Proc, Amer Soc Civil Eng, Vol 93, No IR2, pp 49-66, June 1967. 18 p, 9 fig, 1 tab, 4 ref, 1 append.

Descriptors: *Simulation analysis, *Water quality control, *Digital computers, *River systems, *Irrigation effects, Irrigation systems, Hydrologic data, Dissolved solids.
Identifiers: Sacramento River, Conservative mineral constituents.

A water-quality model compatible with a dynamic hydrologic model and suitable for simulation on the digital computer was presented. The characteristics of a general hydrologic model and two specific models for simulating the operation of irrigation systems were described. By means of the models it was possible to determine at any desired point within the river system, the proportion of water which had been in prior contact with the surface of an irrigation plot. The 'use factor' thus developed could be related to changes in certain conservative quality constituents. The results obtained by simulation of the Sacramento River System were compared to the quality response of the prototype. It was concluded that changes in conservative mineral constituents were closely related to reuse, while constituents involved in biological decomposition processes showed little correlation with reuse. (Gysi-Cornell)
W69-06499

MANPOWER REQUIREMENTS FOR POLLUTION CONTROL AND WATER RESOURCES IN INDIANA AND A RELATED POLLUTION CONTROL TECHNOLOGY CURRICULUM,
Purdue Univ., Lafayette, Ind.
J. P. Lisack.
Purdue University Water Resources Research Center Technical Report 6, March 1969. 64 p, 10 tab, 10 appendix, 22 ref. OWRR Project A-008-IND.

Descriptors: *Manpower, *Education, Employment opportunities, *Occupations, Professional personnel, Water pollution, Air pollution, Water resources, *Professional personnel, Pollution control, Technology.
Identifiers: Technology curriculum, Indiana, Technicians.

The report covers an interdisciplinary study by 4 University departments and representatives from professional organizations in Indiana. In the survey which was conducted it was found that 600 industrial and utility firms, government agencies and educational institutions in Indiana alone have existing job vacancies for 139 engineers, 112 professionals in the physical and life sciences and 175 technicians in the pollution control and water resources development fields. Each year, the same 600 respondents will have job openings for 116 engineers, 87 life and physical scientists and 159 technicians. The report recommends recruitment of students into the disciplines of engineering and life and physical sciences related to environmental and pollution control, and the development of a completely new two-year pollution control technology program in Purdue's School of Technology to meet the critical shortage of trained technicians. This proposed curriculum is unique in that it will provide the training for technicians in water resources, waste water treatment, solid waste treatment, water supply, and air pollution. (Wiersma-Purdue)
W69-06507

SEWERAGE DISTRICTS AND BOARDS.

N J Stat Ann secs 58:12-1 to 58:12-7 (1966).

Descriptors: *New Jersey, *Water pollution control, *Administrative agencies, *Sewage disposal, Sewage effluents, Sewage treatment, Sewage districts, Cities, Municipal wastes, Pollution abatement, Water law, Water pollution sources, Bodies of water, Local governments, Regulation, Investigations, Legislation, Legal aspects, Planning.
Identifiers: Injunctions (Prohibitory), Injunctions (Mandatory).

The phrase 'waters of this state' is expressly defined. The State Department of Health has the power to investigate methods of sewage disposal in order to be better able to make intelligent recommendations for improving such methods and for altering existing sewage treatment works. If the department finds that any of the waters of the state are being polluted, it shall issue notice to the person responsible for such pollution, informing him that he has five years to abate the pollution. He must begin immediately to dispose of the polluting effluent in a manner approved by the department. The department's mandate may be filed in the superior court if such polluting activity is not thereafter discontinued. No sewage may be drained into waters of the state except under such conditions as the department shall approve. Before constructing any sewage plant, plans therefore shall be submitted to the department. The department may seek injunctive relief against violators of the act. Municipalities are required to inform the department of the disposition made of their sewage. Procedures are outlined for the establishment of sewerage districts to include two or more municipalities. (Holt-Fla)
W69-06632

DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
Bechtel Corp., San Francisco, Calif.
Harris H. Burke.
Pap, Amer Soc Civ Eng Nat Meet Water Resour Eng, New Orleans, La, Feb 1969. 31 p, 13 fig.

Descriptors: Dams, *Dam construction, *Dam design, Dam failure, *Solid wastes, *Retention dams, *Earth dams, Mining, Embankments, Construction, Drainage systems, Compaction, Drainage, Pollutants, Slope stability, Safety, Liquefaction.
Identifiers: Dam stability, *Tailings, Drain filters, Construction methods, Pollution control.

Dams for retaining solid wastes are used primarily in the mining industry for disposal of tailings; other uses include storage of (1) fly-ash wastes from large coal-fired steam-electric powerplants, (2) solid wastes from chemical processing, and (3) mineral wastes from oil-recovery operations. If tailings are a serious threat to downstream life and property, they should be retained by a positive wall or dam designed to resist the possible applied loads, rather than relying on the usual upstream building method utilizing tailings alone. Rational design of tailings dams was made possible by the same developments in soil mechanics that proved to be so effective in designing water-retention structures. Introduction of these techniques is helping to improve the hit-or-miss empirical rules previously developed and used in mining and other industries, reducing the possibility of failures while still keeping the cost of waste disposal to an acceptable minimum. Techniques used to build these types of dams are illustrated. (USBR)
W69-06675

WATER POLLUTION CONTROL,
R. Pavanello.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 7, Washington, D C, U S Government Printing Office, pp 991-999, 1968. 9 p, 5 ref.

Descriptors: *Urbanization, *Water pollution control, *Industrial production, Domestic water, Municipal water, Treatment facilities, Training, Research facilities, Waste water, Legislation.
Identifiers: *World Health Organization, Synthetic organic chemicals, International action.

The pollution of surface and ground waters presents a challenge to the health and prosperity of most countries. Although the need for research is prominent in some cases, much is known and technology is available to remedy most of the growing problems of water pollution, provided that there is sound legislation, a good administrative structure, adequate funds and most important, a determination to control water pollution. The World Health Organization has been especially active in the field of water pollution control, and is assisting Member Countries in the evaluation of their problems by conducting surveys of a regional or a national character, and in promoting and advising on the establishment of suitable water pollution control agencies. The Organization makes available to its Member Countries a variety of

technical services to assist in the study of practically every kind of water pollution problem and devotes a sizable portion of its resources in grouping training courses, to the establishment of permanent academic post-graduate facilities, and to individual fellowships, with a view to increasing everywhere the number of persons engaged in combating water pollution. (Sokoloff-Rutgers)
W69-06731

ROLE OF GROUND WATER CONTAMINATION IN WATER MANAGMENT,
Geological Survey, Raleigh, N. C.
Harry E. LeGrand.
Am Water Works Assoc Jour, Vol 59, No 5, pp 557-565, May 1967. 8 p, 1 tab, 6 ref.

Descriptors: *Groundwater, *Water pollution, *Water supply, *Waste disposal, *Water policy, Water managment (Applied), Water resources development, Water quality, Water wells, Aquifers, Hydrogeology, Pollution abatement, Planning, Administration, Costs, Economic feasibility, Municipal water, Streams.

Ground-water contamination aspects should not be excluded in long-range integrated community plans, especially in urban areas and suburbs. They include any deterioration of quality of waste disposal practices, artificial recharge of aquifers, accident, or salt water at shallow or underlying depths. These problems will increase under current practices while minimizing costs calls for coordinated efforts from several disciplines. Technically trained personnel, capable of determining best use of land for water supply and waste disposal, are rarely a part of water-resources administrative machinery. Specific problems are more often dealt with than long-range planning. Complex hydrogeologic conditions must be evaluated before decisions are made and policies established. (Affleck-Ariz)
W69-06762

TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 07B.
W69-06774

OIL AND HAZARDOUS MATERIALS-EMERGENCY PROCEDURES IN THE WATER ENVIRONMENT.
Federal Water Pollution Control Administration, Edison, N. J. North Atlantic Water Quality Management Center.

Dept of Interior, Fed Water Pollut Contr Admin Rep CWR 10-1, Oct 1968. 137 p, 8 ref, 1 append.

Descriptors: *Pollutants, *Pollutant identification, *Water pollution treatment, Oily water, Toxicity, Chemical wastes, Hazards, Poisons, Public health, Cleaning.
Identifiers: *Industrial chemical spills, *Oil spills, Spill handling, Technical manuals.

Procedures for handling oil and chemical spills are given in a technical manual primarily intended for regional FWPCA use. Basic information is provided on the charateristics and effects of pollutants, and procedures to be followed in the event of significant releases to water of oil or other hazardous materials. General information is given on the effects of spills on aquatic life and important water uses including fishing, agriculture, industrial, and domestic. Pollution control measures, health hazard data, and first aid procedures are listed for each pollutant. (Knapp-USGS)
W69-06791

CHESAPEAKE BAY CASE STUDY.
Trident Engineering Associates, Inc., Annapolis, Md.
For primary bibliographic entry see Field 06B.
W69-06794

POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
Federal Water Pollution Control Administration, Washington, D. C.
For primary bibliographic entry see Field 05B.
W69-06802

22 ND INDUSTRIAL WASTE CONFERENCE, 1967, PART ONE,
Purdue Univ., Lafayette, Ind. School of Engineering; and Purdue Univ., Lafayette, Ind. Div. of Conferences and Continuation Services.
For primary bibliographic entry see Field 05D.
W69-06821

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
San Bernardino Valley Municipal Water District, Calif.; and TRW Systems Group, Redondo Beach, Calif.
J. A. Beaver, and M. L. Frankel.
Ground Water, Vol 7, No 3, pp 22-26, May-June 1969. 5 p.

Descriptors: *Water management (Applied), *Systems analysis, *Groundwater, *Long-term planning, *California, Methodology, Water policy, Inter-agency cooperation, Decision making, Pricing, Taxes, Data collections.
Identifiers: *Groundwater management, San Bernardino Valley.

A simplified outline is presented as a favorable study environment for the development of analytic tools and long-range planning needs of effective groundwater management strategies. Situations with real problems and stated objectives are described. A water district in Southern California's San Bernardino Valley is cooperating with private industry and the State in performing an experiment in systems analysis technology as applied to water management. The San Bernardino Valley is similar to other areas in the world where water management reduces to the allocation of locally available groundwater and potential imported water. (Lang-USGS)
W69-06424

CIVIL ENGINEERING AND URBAN SYSTEMS,
Northwestern Univ., Evanston, Ill.
George L. Peterson, Robert S. Gemmell, Richard D. Worrall, and Donald S. Berry.
Proc Amer Soc Civil Eng, Vol 95, No UP1, pp 1-14, Apr 1969. 14 p, 2 fig, 5 ref.

Descriptors: *Civil Engineering, *Systems analysis, *Urbanization, Social needs, Water supply, Waste disposal, Transportation, Economics, Mathematics, Environmental engineering, Analytical techniques, Decision making, Planning, Design.
Identifiers: Urban Systems Engineering.

A new engineering activity, Urban Systems Engineering, using the tools of mathematics, economics, and the social, behavioral and institutional sciences, all founded on an engineering base, was described. The analytic methodology, theories and descriptions of the behavior of urban systems and institutions, and the use of inductive and deductive quantitative methods which are particularly important were outlined. Included in urban services which should be engineered as systems were water supply, waste disposal, transportation, health services, power supply, education, recreation, communication, protection (fire, police) and others. The responsibility of the civil engineering profession in meeting the challenge and opportunity of Urban Systems Engineering was stressed. (Gysi-Cornell)
W69-06491

PIPELINE PLANNING BY DYNAMIC COMPUTER PROGRAMMING,
Tahal Construction Engineers Ltd., Tel Aviv (Israel).
Elisha Kally.
J Amer Water Works Ass, Vol 61, No 3, pp 114-118, Mar 1969. 5 p, 6 fig, 2 ref.

Descriptors: *Dynamic programming, *Pipelines, *Design, *Planning, *Computer programs, Hydraulic gradient, Pressure head, Pressure conduits, Cost comparisons, Optimization, Probability, Timing, Discharge (Water), Digital computers.
Identifiers: Variable discharge.

A dynamic programming approach was described which made possible the minimum cost design of a pipeline with the aid of a digital computer. The first method assumed a given set of flow data for which the optimal design was determined. Accuracy and speed of the program was dependent on the pipeline segmentation and interval spacing chosen for pressure heads at segment ends. A second method considered possible flow variations with known probability distributions for which the design with lowest expected cost was found. Finally, the possibility of increasing discharge requirements with time was handled by treating time increments as the stages (rather than pipe segments as in method 1), and treating capacity expension increments as decision variables at each stage. For the latter method the minimum cost of supplying a required capacity at any given point in time could be found. (Gysi-Cornell)
W69-06493

SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE.
Texas Water Development Board, Austin; and Water Resources Engineers, Inc., Lafayette, Calif.
For primary bibliographic entry see Field 04A.
W69-06494

THE DESIRABILITY AND APPLICABILITY OF SIMULATING ECOSYSTEMS,
Battelle Memorial Inst., Columbus, Ohio.
R. S. Davidson, and A. B. Clymer.
Ann NY Acad Sci, Vol 128, Art 3, pp 790-794, Jan 31, 1966. 1 fig, 17 ref.

Descriptors: *Ecosystems, *Model studies, *Simulation analysis, Eutrophication, Computer models, Computers, Nutrients, Trophic level, Productivity, Aquatic environment, Phytoplankton, Zooplankton, Analog models, Systems analysis.
Identifiers: Aquatic ecosystem model, Simulation model, Mid-Atlantic seaboard, Algal bloom.

A mathematical model simulating aquatic ecosystems was developed by assuming uniform distribution of all variables in a column of water, where: all variables were adequately represented by averages over 24 hours; phytoplankton and zooplankton were the only biological components; illumination and water temperature had sinusoidal yearly curve; only one critical nutrient was present; no difference between growth and reproduction was indicated; and the location was the mid-Atlantic seaboard. Twelve appropriate constants were used in the model. The simulation of aquatic ecosystems was reasonably approached. The spring bloom of phytoplankton was 1000 times greater than the winter bloom. Regular summer and fall blooms of small magnitude also appeared. Peak of spring bloom occurred when the nutrient approached zero, and peak of zooplankton occurred slightly after the algal bloom as expected. (Teraguchi-Wis)
W69-06537

THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT: A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 05F.
W69-06547

FIRST ORDER AUTO REGRESSION: INFERENCE, ESTIMATION, AND PREDICTION,
International Bank for Reconstruction and Development, New York; and Office of the Secretary of Defense, Washington, D. C.
Guy H. Orcutt, and Herbert S. Winokur, Jr.
Econometrica, Vol 37, No 1, pp 1-14, January 1969. 14 p, 8 tab, 24 ref.

Descriptors: *Forecasting, *Monte Carlo study, Estimating, Time series analysis, Regression analysis, Least squares method.
Identifiers: *First order autoregression, *Inference, *Estimation, Level, Slope, Error variance, T-distribution, Chi-square distribution, Bias, Chained prediction.

Monte Carlo techniques are used to study the first order autoregressive time series model with unknown level, slope, and error variance. The effect of lagged variables on inference, estimation, and prediction is described using results from the classical normal linear regression model as a standard. In particular, use of the t and Chi-square distributions are approximate sampling distributions is verified for inference concerning the level and residual error variance. Bias in the least squares estimate of the slope is measured and two bias corrections are evaluated. Least squares chained prediction is studied, and attempts to measure the success of prediction and to improve on the least squares technique are discussed. This article would be of interest to the water researcher concerned with econometric analyses of water demand conditions. (Loeb-Rutgers)
W69-06550

LEAST SQUARES, CONDITIONAL PREDICTIONS, AND ESTIMATOR PROPERTIES,
Institute for Defense Analyses, Arlington, Va.
Wade P. Sewell.
Econometrica, Vol 37, No 1, pp 39-43, January 1969. 5 p, 10 ref.

Descriptors: *Least squares method, Forecasting, Regression analysis.
Identifiers: *Conditional prediction, *Estimated properties, Normal disturbances, Bias, Consistency, Asymptotic unbiasedness, Two-stage least-squares.

The problem of prediction of a subset of the endogenous variables conditioned on the balance of the endogenous variables, as well as the predetermined variables, is discussed in the context of a general linear model with normal disturbances. It is shown that the conditional least-squares predictor is unbiased correcting Srinivasan's treatment of a paper by Waugh. In the course of the argument, a simple derivation of the multivariate t density is presented. Srinivasan's remark that the consistency of an estimator does not imply its asymptotic unbiasedness (in one of the common senses of that term) is illustrated by two examples, one with a discrete and one with a continuous distribution. These examples show that neither asymptotic unbiasedness nor zero asymptotic variance is necessary for consistency. The example with a continuous distribution is the two-stage least-squares estimator. This article is of particular interest to the water researchers using conventional least squares analysis with respect to the predictive and simulation accuracy of their results and the classical properties of the estimators. (Loeb-Rutgers)
W69-06551

THE USE OF ERROR COMPONENTS MODELS IN COMBINING CROSS SECTION WITH TIME SERIES DATA,
North Carolina State Univ., Raleigh; and Islamabad Univ., Rawalpindi (Pakistan).
T. D. Wallace, and Ashig Hussain.
Econometrica, Vol 37, No 1, pp 55-72, January 1969. 18 p, 15 ref, 5 append.

Descriptors: Time series analysis, Regression analysis, Least squares method.
Identifiers: *Error component, *Cross section data, *Time series data, Aitken estimator, Covariance estimator, Iterative estimator.

A mixed model of regression with error components is proposed as one of possible interest for combining cross section and time series data. For known variances, it is shown that Aitken estimators and covariance estimators are in one sense asymptotically equivalent, even though the Aitken estimators are more efficient in small samples. Turning to unknown variance components, Zellner-type iterative estimators are compared with covariance estimators. Here few small sample properties are obtained. However, it is shown that covariance and Zellner-type estimators have equivalent asymptotic distributions and equivalent limits of sequences of first and second order moments for weakly nonstochastic regressors. For the model analyzed, the theoretical results obtained, as well as ease of computation, tend to support traditional covariance estimators of the regression parameters. This article improves the pooling technique for cross-section and time series data and can be used in empirical water demand research to avoid problems of least squares bias and multicolinearity that are inherent in the use of only time series data. (Loeb-Rutgers)
W69-06552

AN HARMONIC ANALYSIS OF NONSTATIONARY MULTIVARIATE ECONOMIC PROCESSES,
London School of Economics and Political Science (England); and Osaka Univ. (Japan). Inst. of Social and Economic Research.
David R. Brillinger, and Michio Hatanaka.
Econometrica, Vol 37, No 1, pp 131-141, January 1969. 11 p, 22 ref.

Descriptors: *Fourier analysis, Regression analysis.
Identifiers: *Nonstationary process, Power spectrum, Cross-spectrum, Partial cross-spectrum, Estimation, Simultaneous equations, Stationary process.

This paper presents an heuristic introduction to the harmonic analysis of a class of nonstationary processes and develops the estimation techniques required for such processes. The introduction is carried out via the notion of a frequency component for both a stationary and a nonstationary process. This form of presentation has the advantage of leading directly to the definitions of power spectrum, cross-spectrum and partial cross-spectrum for stationary processes, and their moving analogues for nonstationary processes. The problem of the formulation and estimation through harmonic analysis, of a system of simultaneous equations is also considered. Harmonic and spectral analysis may be of potential use to water flow and simulation studies. (Loeb-Rutgers)
W69-06553

LONG-RUN COEFFICIENTS AND DISTRIBUTED LAG ANALYSIS: A REFORMULATION,
Hebrew Univ., Jerusalem (Israel).
Yair Mundlak.
Econometrica, Vol 35, No 2, pp 278-293, April 1967. 16 p, 9 ref, 1 append.

Descriptors:
Identifiers: *Long-run coefficients, *Distributed lag analysis, Comparative statics, Short-run variable, Dynamic formulations, Adjustment equations, Recursiveness.

The difficulty of obtaining empirical coefficients of long-run economic relations stems from the fact that long-run equilibrium values of economic variables are unobservable. To overcome this difficulty, assumptions are usually made about the relationships between observed and the unobserved long-run variables. Such assumptions have led to distributed lag analysis. In an earlier paper the author has shown that such an approach is likely to give erroneous results, for the adjustment process may not be consistent with the comparative statics solutions for the short-run variables. In the present paper, the earlier analysis is supplemented and it is also shown how the problem can be overcome and how the long-run coefficients can be estimated even though the long-run equilibrium values are unobserved. The basic deviation from other formulations of this subject is that adjustment equations are used to describe only those movements of variables about which comparative statics has nothing to say. In this way, contradictions between comparative statics and ad hoc dynamic formulations are avoided. This article may be relevant to studies dealing with long run water demand and use via stochastic estimating techniques. (Loeb-Rutgers)
W69-06557

SPECIFICATION AND ESTIMATION OF COBB-DOUGLAS PRODUCTION FUNCTION MODELS,
Chicago Univ., Ill.; Michigan State Univ., East Lansing; and Louvain Univ. (Belgium).
A. Zellner, J. Kmenta, and J. Dreze.
Econometrica, Vol 34, No 4, pp 784-795, October 1966. 12 p, 14 ref.

Descriptors: *Specifications, Sampling, Estimating, Profits, Regression analysis.
Identifiers: *Estimation, *Cobb-Douglas production function, Profit maximization, Sampling theory, Bayesian estimation techniques, Classical least squares.

This paper considers the specification and estimation of the Cobb-Douglas production function model. After reviewing the 'traditional' specifying assumptions for the model which are based on deterministic profit maximization, a model is developed in which profits are stochastic and in which maximization of the mathematical expectation of profits is posited. 'Sampling theory' and Bayesian estimation techniques for this model are presented. This paper is relevant for water studies concerned with developing empirical production functions of water supply and the effects of uncertain profit conditions on the production function. (Loeb-Rutgers)
W69-06560

THE ESTIMATION OF NONLINEAR ECONOMETRIC SYSTEMS,
International Business Machines Corp., New York.
Harry Eisenpress, and John Greenstadt.
Econometrica, Vol 34, No 4, pp 851-861, October 1966. 11 p, 1 tab, 5 ref.

Descriptors: Regression analysis.
Identifiers: *Nonlinear econometric systems, Newton method, Parameter, Ordinary least-squares, FIML, Two-stage least-squares, LIML, Identification, Gradient method.

The estimation of parameters of linear econometric systems, for single-equation methods as well as system methods, is now feasible. In a previous paper a computer program for the calculation of estimates by most of these methods was described. The present paper presents an extension of this work to the nonlinear area, i.e., to systems that are nonlinear in the parameters and/or endogenous variables. In particular, an experimental program permits computation of nonlinear ordinary least-squares and full-information maximum likelihood estimates. As regards other methods that are currently used with linear systems, viz., two-and-three-stage least-squares and limited-information maximum likelihood, it appears at present that the extension to nonlinear systems is not feasible. The

problem of identification in nonlinear systems is not treated since it has not been fully solved. The extension of econometric investigations into nonlinear problems gives water researchers important additional flexibility in their empirical investigations. This article, therefore, has relevance to improving the general econometric methodology that is available to water analyses. (Loeb-Rutgers)
W69-06562

LINEAR PROBABILITY FUNCTIONS AND DISCRIMINANT FUNCTIONS,
Iowa State Univ. of Science and Technology, Ames.
George W. Ladd.
Econometrica, Vol 34, No 4, pp 873-885, October 1966. 13 p, 1 fig, 10 ref.

Descriptors: Regression analysis, Probability.
Identifiers: *Linear probability function, *Discriminant function.

Linear probability functions are briefly discussed and the theory of linear discriminant functions in the two-class case is then presented. Such a function, which is a linear combination of observed variables, is used to classify each observed item into one of two classes. Certain identities between the two types of functions are obtained. Whereas the results from the two different models are the same, their distributional assumptions and derivations are quite different. Several water recreation demand studies have used least squares regression techniques to estimate a binary dependent variable function. This article has relevance to these and similar studies since it presents the properties of other estimating techniques for qualitative dependent variable equations. (Loeb-Rutgers)
W69-06563

MAXIMIZATION BY QUADRATIC HILL-CLIMBING,
Princeton Univ., N. J.
Stephen M. Goldfeld, Richard E. Quandt, and Hale F. Trotter.
Econometrica, Vol 34, No 3, pp 541-551, July 1966. 11 p, 4 tab, 9 ref, 1 append.

Descriptors:
Identifiers: *Maximization, *Quadratic hill-climbing, *Gradient method, Algorithm, Concavity, Quadratic approximation, FIML, Eigenvalue, Newton's method.

The purpose of this paper is to describe a new gradient method for maximizing general functions. After a brief discussion of various known gradient methods the mathematical foundation is laid for the new algorithm which rests on maximizing a quadratic approximation to the function on a suitably chosen spherical region. The method requires no assumptions about the concavity of the function to be maximized and automatically modifies the step size in the light of the success of the quadratic approximation to the function. The paper further discusses some practical problems of implementing the algorithm and presents recent computational experience with it. This type of procedure may be helpful to the researcher in the field of water problems using econometric iterative procedures. (Loeb-Rutgers)
W69-06564

TESTING SINGLE-EQUATION LEAST SQUARES REGRESSION MODELS FOR AUTOCORRELATED DISTURBANCES,
Michigan State Univ., East Lansing.
Richard C. Henshaw, Jr.
Econometrica, Vol 34, No 3, pp 646-660, July 1966. 15 p, 3 tab, 9 ref.

Descriptors: *Regression analysis, Statistical models, Markov processes.
Identifiers: *Autocorrelated disturbances, *Regression models, von Neumann ratio, Durbin-Watson test, Theil-Nagar test, Maximum likelihood estimates.

The basic theory upon which several well-known tests of the independence of least squares regression disturbances are based is reviewed and then applied to formulate a testing procedure which is inexpensive when a large-capacity, high speed electronic computer is employed. Investigations to date indicate that the significance points of the von Neumann ratio, which can be obtained by this procedure, are accurate to the order required in practical work even when the number of degrees of freedom is small, and the test is always conclusive. This is encouraging since the results from attempts to apply the Durbin-Watson or the Theil-Nagar tests frequently may be inconclusive or of doubtful accuracy. Consideration is also given to the question of what to do when the null hypothesis of residual independence is rejected. Water demand and flow simulation equations using small sample time series data can refer to the conclusions of this article when treating the validity of random residual behavior in the particular estimated equations. (Loeb-Rutgers)
W69-06565

SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
Stanford Univ., Palo Alto, Calif.
Takeshi Amemiya.
Econometrica, Vol 34, No 2, pp 283-306, April 1966. 24 p, 4 tab, 10 ref.

Descriptors: *Estimating, Stochastic processes.
Identifiers: *Specification analysis, *Estimation, *Modified two-stage least squares, *Two-stage least squares, *Simultaneous equation model, *Autoregressive residuals, Bias.

Several related estimators of the parameters of a single equation of a simultaneous equation model are proposed. They are shown to be consistent and asymptotically efficient when the residual of the equation follows the first-order autoregressive process. One of the estimators, called MS2SLS, is designed to be consistent under a more general assumption about the stochastic process of the residual. A numerical analysis shows that the efficiency of MS2SLS is much higher than that of 2SLS under a general assumption about the stochastic process of the residual. As such, this might be of aid to researchers analyzing water problems via econometric methods. (Loeb-Rutgers)
W69-06567

A PARAMETRIC SIMPLICAL FORMULATION OF HOUTHAKKER'S CAPACITY METHOD,
Groningen Rijksuniversiteit (Netherlands); and Virginia Univ., Charlottesville, Va.
C. Van De Panne, and Andrew Whinston.
Econometrica, Vol 34, No 2, pp 354-380, April 1966. 27 p, 2 fig, 7 tab, 7 ref.

Descriptors: Constraints, Linear programming.
Identifiers: *Houthakker's capacity method, *Quadratic programming, Simplex method, Dual method, Parametric simplical formulation, Quadratic simplex tableaux.

The paper reformulates Houthakker's capacity method for quadratic programming in the framework of the simplex and dual methods for quadratic programming, thereby greatly reducing the conceptual and computational complexities of the method. It is shown that the method is applicable for all convex quadratic programming problems, including the case of a semi-definite matrix of the quadratic form and that of constraints in equality form. In the linear programming case the method reduces to a parametric version of the dual method. In view of the increasing use of computers and computer problem solving by water researchers, this paper may prove to be relevant to certain water area problems. (Loeb-Rutgers)
W69-06568

SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS,
Aerospace Research Labs., Wright-Patterson AFB, Ohio; and Douglas Aircraft Co., Inc., Santa Monica, Calif.
P. R. Krishnaiah, and V. K. Murthy.
Econometrica, Vol 34, No 2, pp 472-480, April 1966. 9 p, 9 ref.

Descriptors: *Markov processes.
Identifiers: *Simultaneous tests, *Trend, *Serial correlation, *Gaussian Markov residuals, Autocorrelation, Confidence interval, First order Markov process.

By extending a result of Ogawara, the problem of estimating the trend parameters when the residuals are serially correlated according to an hth order stationary Gaussian Markov process is reduced to the classical case where the residuals are uncorrelated and hence independent in view of normality. In this paper the problems of testing for the trend and other simultaneous hypotheses on the parameters are considered when the residuals are respectively a first and a general hth order Markov process of normal variates. Exact tests are obtained for testing the trend in the presence of autocorrelation and also for testing the trend and autocorrelation simultaneously in a first order Markov process. The simultaneous confidence bounds associated with these tests are also derived. These results are extended to the hth order Markov process. For a general stationary Markov process, exact tests are proposed for testing the hypothesis of (i) no trend in the presence of serial correlation, (ii) independence among error, and (iii) independence and no trend among errors. Water flow simulation studies employing Markov schemes will find this paper applicable to the issues and problems of such models. (Loeb-Rutgers)
W69-06569

NONRECURSIVE MODELS AS DISCRETE APPROXIMATIONS TO SYSTEMS OF STOCHASTIC DIFFERENTIAL EQUATIONS,
London School of Economics and Political Science (England).
A. R. Bergstrom.
Econometrica, Vol 34, No 1, pp 173-182, January 1966. 10 p, 1 tab, 9 ref.

Descriptors: Estimating, Approximation method.
Identifiers: *Nonrecursive models, *Discrete approximation, *Differential equations, Specification error, Restrictions, Reduced form parameters, Variance.

This article is concerned with the specification error implied by the use of a non-recursive model as a discrete approximation to a system of stochastic differential equations. One of these questions considered is whether, in view of this specification error, it is better, for the purpose of prediction, to ignore the overidentifying restrictions and estimate the reduced form parameters directly. Another is the question of how to make the best use of the estimates of the parameters of the approximate model in order to obtain estimates of the parameters of the exact model. These questions are relevant to water research investigations using a non recursive model as a framework for portraying the water market. (Loeb-Rutgers)
W69-06571

SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
Cleveland Electric Illuminating Co., Ohio; and Westinghouse Electric Corp., Pittsburgh, Pa.
W. R. Ossman, R. C. Craft, and N. H. Woodley.
Pap 69 TP 35-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1969. 10 p, 10 fig, 1 tab, 4 ref.

Descriptors: *Probability, *Reliability, Power transformers, Risks, *Substations (Electrical),

Loading rate, *Policy matters, *Expansion, Weather data, Growth rates, Temperature, Electrical equipment, Losses, Economics, Operating costs, Investment, Capital costs, Replacement costs, Computer programming.
Identifiers: Analytical method, *Service life, Outages.

The first known attempt to apply probability methods to the evaluation of substation expansion plans and transformer loading policies is discussed. The method (using local historical substation load and ambient temperature environmental conditions) develops the probabilities of exceeding maximum transformer temperatures and the expected loss of transformer life. Alternate substation expansion plans to meet the forecast area load are compared on the basis of cost versus reliability. The acceptable risk value can be used as the threshold risk level for triggering the installation of new substation capacity in the system area represented. The method will produce uniform risk values throughout the simulated expansion pattern. If the expansion pattern is followed in loading throughout a power system, a substation operation policy based on uniform risk will result. (USBR)
W69-06685

INTERREGIONAL PRODUCTION AND WATER RESOURCE DEPENDENCIES AMONG THE WESTERN STATES,
British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 06B.
W69-06721

OPTIMALITY OF IMPERFECTLY COMPETITIVE RESOURCE ALLOCATION,
Case Western Reserve Univ., Cleveland, Ohio.
For primary bibliographic entry see Field 06C.
W69-06722

QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
California Univ., Los Angeles. Dept. of Engineering; and Nevada Univ., Reno. Dept. of Water Resources.
For primary bibliographic entry see Field 02A.
W69-06822

SYSTEMS APPROACH FOR INTEGRATING GROUND WATER AND SURFACE WATER USE.
Aerojet-General Corp., El Monte, Calif. Environmental Systems Div.; and Engineering-Science, Inc., Arcadia, Calif.

Available from Clearinghouse as PB 184 236 at $3.00 in paper copy and $0.65 in microfiche. Aerojet-Gen Corp Rep no 1175 F to Office Water Resources Res, Dept of Interior, Nov 1968. 100 p, 24 fig, 5 tab, 37 ref. OWRR Contract no 14-01-0001-1521.

Descriptors: *Water resources, *Water supply, *Water utilization, *Systems analysis, *California, Mathematical models, Computers, Decision making, Water policy, Water management (Applied), Surface waters, Groundwater, Irrigation water, Municipal water, Water reuse.
Identifiers: Fresno (Cal).

A systems approach to conjunctive groundwater-surface water use integrates many relevant factors such as water needs, projected needs, water availability, water chemistry, water quality, legal aspects, financial aspects, costs, benefits, and sociological aspects. Historical data for the Fresno area, California, were analyzed as a basis for projections to the year 2000. Agricultural demand is predicted to decrease from 93 to 86% of total demand in the projection period 1967-2000, while municipal and industrial demand will increase from 7 to 14%. Total demand is expected to increase from about 3 to about 5 million acre-ft per year. Water sources are surface water from the Kings River System (80%), San Joaquin System (18%), and foothill runoff (2%), groundwater, and direct precipitation. Surface sources can supply about 37% of total demand, direct precipitation 4.5%, and groundwater, 63.5%. All the projected increase must come from groundwater, and water levels are already declining at an average annual rate of 2 ft, and projected rates will lower levels from 60 ft in 1967 to 275 ft in 2000. With heavy pumping, salt concentration will reach 320 mg/liter by 2000. Agricultural water costs are $2.40/ac-ft for surface water and $11.60/ac-ft for groundwater, while municipal users are charged $34.40/ac-ft. Water law and proposals for water reclamation are outlined. (Knapp-USGS)
W69-06834

6B. Evaluation Process

WATER RESOURCES AND THE URBAN ENVIRONMENT,
Virginia Polytechnic Inst., Blacksburg.
For primary bibliographic entry see Field 04C.
W69-06428

INTERGOVERNMENTAL PLANNING OF WATER RESOURCES,
Water Resources Council, Washington, D.C.
Harold G. Wilm.
Ground Water, Vol 7, No 2, pp 15-17, Mar-Apr 1969. 3 p.

Descriptors: *Water resources development, *Planning, Water Resources Planning Act, Water Resources Research Act, Interstate commissions, Optimum development plans, River basin development.
Identifiers: *Water Resources Council.

The 20th century has seen dramatic increase of activity in the water resources development field, with a concomitant increase in Federal participation. A Senate Select Committee's report was the basis for the Water Resources Research Act of 1964 and the Water Resources Planning Act of 1965. The objective of the Water Resources Planning Act is to provide for optimum development of water resources through the Water Resources Council and several River Basin Commissions, and by providing financial assistance to the States in order to increase State participation in water resources planning. River basin studies include population, economic development, and water supply and water use data projected as far as the year 2020. The Water Resources Council also prepares a biennial assessment of the adequacy of water supplies in each water resource region in the United States. For this purpose a river basin model is being prepared for 300 basins, incorporating economic concepts for determination of optimum water use alternatives. Under Title I of the Water Resources Planning Act is the preparation of guidelines for all Federal participants in comprehensive regional water planning, and for the formulation and evaluation of Federal water resources projects of all types. The Council also is working on specific proposals for improved floodplain management. Title II of the Act authorizes the President to establish river basin commissions at the request of one or more States and with concurrence by the Council. Title III provides a basis for increased participation by the States by granting of matching funds. All but two States are now taking part in the State Grant program. (Knapp-USGS)
W69-06429

THE INFLUENCE OF OWNERSHIP AND CONTROL ON PROFIT RATES,
Missouri Univ., Columbia.
David R. Kamerschen.
American Economic Review, Vol LVIII, No 3, pp 432-447, June 1969, 15p, 2 tab, 20 ref.

Descriptors: *Profit, Return, Management, Industries, Growth rates.
Identifiers: Management control, Barriers to entry, Ownership, Industry growth, Rates, Assets.

This study extends Larner's analysis to determine whether the extent of management control exerts an important influence on the rate of return in firms. The author submits that it does not. The main conclusions of the study where average profit rates on equity were the dependent variable are these: (1) Two of the management-related variables with which Larner was concerned do not appear to explain much of the variation in profit rates. However, a dummy variable measuring a change in the ultimate control from non-management to management had a significant positive coefficient. This is apparently at variance with most of the non profit maximization theories of the firm that stress the importance of nonpecuniary motives of managers. (2) Other variables which seem to be the proximate determinants of rates of return and for which theoretical support can be given are total assets, barriers to entry and industry growth rate. This article may be relevant in helping to evaluate questions concerning whether water resources and supplies should be developed in a private market or public good framework. (Winn-Rutgers)
W69-06545

IMPLICATIONS OF PROPERTY RIGHTS FOR GOVERNMENT INVESTMENT CHOICES,
George Washington Univ., Washington, D.C.
Louis De Alessi.
American Economic Review, Vol LIX, No 1, pp 13-24, March 1969, 11 p, 41 ref.

Descriptors: *Cost-benefit analysis, *Decision making, Costs, Benefits, Discount rate, Governments, Investments.

The government has been making increased use of cost-benefit analysis as a device for discriminating among alternative governmental investment options. One limitation of this analysis which has not been fully recognized is the bias inherent in decisions made in an environment marked by the absence of private property rights. Section I of this paper suggests that in a wider variety of cases than may be generally recognized, cost-benefit analysis cannot yield an unambiguous ranking of projects under consideration. Moreover, present value benefit-cost data frequently mask information relevant to the choice. Section II briefly presents a utility maximization model and shows some of its implications for decision making within the government. Section III considers some aspects of the current debate on what discount rate should be used in evaluating government investments. This article is relevant for the selection of projects in a water resource development program via cost-benefit criteria. (Winn-Rutgers)
W69-06548

ECONOMIC ANALYSIS OF THE DEVELOPMENT POTENTIAL OF THE COMMERCIAL FISHERIES INDUSTRY OF THE COASTAL PLAINS REGION,
Clemson Univ., S.C.
J.C. Hite, and J.M. Stepp.
Economics of Marine Resources, No 1, Clemson, Clemson University, 1969. 78 p, 7 fig, 13 tab, 18 ref.

Descriptors: *Fisheries, *Coastal Plains, Marine fisheries, Commercial fishing, Industries, Regions, Georgia, North Carolina, South Carolina, Income, Employment opportunities, Marketing, Export, Agriculture, Supply, Economics, Regional analysis, Shrimp, Oysters.
Identifiers: *Export base concept, Processing facilities, Regional development.

The principal purpose of this report is to examine the development potential of the commercial fisheries of the Coastal Plains in terms of its ability to generate income and improve the economic well-being of the people in the Region. The export base concept is used as a framework for this examina-

tion. It is noted that increases in regional income are directly related to increases in the level of exports from the Coastal Plains Region to other regions, and consequently, the development potential of the commercial fisheries industry is dependent upon its current position in the economic base of the Region and its ability to successfully engage in interregional competition. It is concluded that the potential growth in regional income which can be stimulated by increasing the exports of the commercial fisheries' products from the Region is somewhat limited. (Winn-Rutgers)
W69-06554

ECONOMIC EFFECTS OF MINERAL CONTENT IN MUNICIPAL WATER SUPPLIES.
Black and Veatch, Kansas City, Mo.
For primary bibliographic entry see Field 03A.
W69-06555

A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS: PART 1,
Brigham Young Univ., Provo, Utah; and Dow Chemical Co., Midland, Mich.
For primary bibliographic entry see Field 03C.
W69-06556

THE POTENTIAL CONTRIBUTION OF DESALTING TO FUTURE WATER SUPPLY IN TEXAS.
Southwest Research Inst., Houston, Tex.; and Texas Water Development Board, Austin.
For primary bibliographic entry see Field 03A.
W69-06558

MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
Southwest Research Inst., Houston, Tex.; and Texas Water Development Board, Austin.
For primary bibliographic entry see Field 03A.
W69-06559

AGGREGATE KOYCK FUNCTIONS,
Oregon Univ., Eugene.
G. O. Bierwag, and M. A. Grove.
Econometrica, Vol 34, No 4, pp 828-832, October 1966. 5 p, 10 ref.

Descriptors: Income, Regression analysis.
Identifiers: *Aggregate Koyck function, Random variable, Adaptive expectation, Pascal distributed lag, Expectations, Nerlove's model of supply, Permanent income.

The specification of dynamic relations in economic theory often requires knowledge of the expectations of economic units. Since direct evidence of the way in which expectations are formed is rarely available, it is often assumed that expectations of the future value of a given variable depends on part observed values of the variable. The distributed lag function of Koyck is a convenient representation of this functional dependence and has been widely employed in the literature. An interesting problem arises, however, when the expectations relevant to a model represent an aggregation of the expectations of individual transactors. In a variety of models, some of which are explored in this paper, the aggregate expectation in the market may be regarded as a weighted average of the expectations of individual transactors. Given this form of aggregation, it is demonstrated that if each individual transactor's expectation function is a Koyck function, the aggregate expectation function is not a Koyck function unless the expectation of individual transactors are identical. The role of expectations in water demand and supply functions is of importance due to the uncertainty of water supply conditions and therefore this article has relevance to attempts to introduce aggregate expectations in water analysis. (Loeb-Rutgers)
W69-06561

CONFERENCE ON WATER DECISIONS IN THE CRITICAL 1960's,
California University, Davis. Water Resources Center.
Robert Hagan, and Vincent Lawton.
Water Resources Center Rept. No. 3. See also W69-06573 thru W69-06583. Proceedings of Conference at University of California at Davis, Jan 11-13, 1961.

Descriptors: *Water policy, *Water allocation (Policy), Water quality, Water demand, Legal aspects, Agriculture, Industries, Domestic water, Recreation, Economics, Nuclear energy, Desalination, California.

This book contains the proceedings of a water policy conference held at the University of California at Davis. The purpose of the conference was to help provide the background for water decisions to be made. The book contains five major subdivisions. The first section outlines the challenges ahead. The next section describes the competition for water quality, while the third part describes the competition for water quantity. Some of the choices which have to be made in a water resource development program are presented in the following section. The last section discusses the status of atomic energy and sea water conversion. (Winn-Rutgers)
W69-06572

NUCLEAR REACTORS,
California Univ., Berkeley.
For primary bibliographic entry see Field 03A.
W69-06582

ALLOCATION AND REALLOCATION OF WATER RESOURCES,
Department of the Interior, Washington, D. C.; and Corps of Engineers, Washington, D. C.
Elmo R. Morgan, F. P. Koisch, and Floyd E. Dominy.
J Amer Water Works Ass, Vol 61, No 1, pp 17-30, Jan 1969. 14 p.

Descriptors: *Water resources, *Policy matters, Planning, *Investment, Project planning, *Fish and wildlife, *Groundwater, Legal aspects, Water law, *Water allocation (Policy), Cost allocation, Water quality, *Water resources development, Northeast U.S., Resource development, *Resource allocation.
Identifiers: North Atlantic Basin, Bureau of Reclamation, Corps of Engineers.

National policy, project planning approaches, public investment, fish and wildlife, and groundwater aspects of water resources allocation were presented in a joint discussion at the Annual Conference of the American Water Works Association. The conference was held in Cleveland, Ohio, in June 1968. Among the points discussed were : (1) responsibilities, interpretation, analysis, legal powers, and flexibility of a National policy; (2) the North Atlantic and Northeastern Regional Water Resources Studies of the Corps of Engineers; (3) economic policy of the Bureau of Reclamation regarding water resources projects; (4) values and benefits of fish and wildlife on water resource projects; and (5) the role ground-water management plays in allocation of water resource development. (USBR)
W69-06691

THE CES PRODUCTION FUNCTION: A DERIVATION,
Rutgers - The State Univ., New Brunswick, N. J.
V. Kerry Smith.
The American Economist, Vol 13, No 1, pp 72-76, Spring 1969. 5 p, 4 fig, 4 ref.

Descriptors: Leontief models, Input-output analysis.
Identifiers: *CES production function, *Elasticity of substitution, Marginal rate of substitution, Cobb-Douglas production function.

The Constant Elasticity of Substitution production function provides a whole new dimension to productive relationships. By permitting the elasticity to take on values different from zero or one, it enables a more explicit treatment of the technological structure 'in back of' production. This paper suggests a two stage derivation procedure which first examines the economic implications of the constancy of the elasticity of substitution, and then builds upon this foundation a simplified derivation of the CES function. A graphical illustration is provided indicating that the greater the value of the elasticity of substitution, the flatter the constant product curve or isoquant, and correspondingly the more slowly does the marginal rate of substitution of capital for labor increase as one factor is substituted for the other. This article would be relevant to the water researcher concerned with both theoretical and empirical water supply and production analysis. (Loeb-Rutgers)
W69-06720

INTERREGIONAL PRODUCTION AND WATER RESOURCE DEPENDENCIES AMONG THE WESTERN STATES,
British Columbia Univ., Vancouver.
H. Craig Davis.
Western Economic Journal, Vol 7, No 1, pp 27-40, March 1969. 14 p, 5 tab, 17 ref.

Descriptors: *Input-output analysis, Regions, Arizona, California, Idaho, New Mexico, Oregon, Utah, Washington, Nevada, Montana, Water resource development, Water transfer.
Identifiers: *Interregional production, *Water resource dependencies, *Western states, Western Pacific states, Montain states.

In the last five years a considerable portion of the research in the area of regional economics has been directed towards the construction of input-output models. Of the eleven continental western Pacific and Mountain states, no fewer than seven--Arizona, California, Idaho, New Mexico, Oregon, Utah, and Washington--have completed input--output studies of their respective state economies. In addition, plans have been formulated for the construction of input-output tables for at least two more western states, Nevada and Montana. The purpose of the present paper is to set forth some of the methods by which these state input-output models can be utilized for the analysis of interregional interdependencies, partifularly in the area of water resource development which is a subject of increasing concern in the western United States. The methods discussed are illustrated wherever possible with the results of empirical research pertaining to the eleven western states. (Loeb-Rutgers)
W69-06721

THE GENERAL WATER SCHEME - AN ESSENTIAL BASIS FOR THE MOST RATIONAL USE OF WATER RESOURCES,
Heinz Muhleck.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, Washington, D C, U S Government Printing Office, pp 192-199, 1968. 8 p.

Descriptors: *Water management, *Water resources, *Water balance, Legal aspects, Water quality, Future planning, Flood protection, Water pollution control.
Identifiers: *General Water Schemes, Federal Republic of Germany, Comprehensive survey.

In every river basin, there are many possibilities to make use of the water resources for meeting the demands. To ascertain such possibilities, to compare these with each other and to appraise them by having regard to the supraregional viewpoints and tak-

ing into consideration the water economy is the actual work of the planning expert. The general water schemes are established under the direction of an engineer, but are the joint work of quite a number of technical disciplines, ranging from meteorologists, hydrologists, geologists, limnologists and many other technical faculties of natural science, to socioeconomists. In the Federal Republic of Germany, general water schemes were already established prior to the coming into force of the Directives, and which, in principle, correspond to the Directives. In particular, in Land Hessen, various general water schemes have been elaborated and others are under consideration in connection with a comprehensive regional planning scheme, the 'Grobe Hessenplan.' (Sokoloff-Rutgers)
W69-06724

SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
Adam A. Sokoloski.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, Washington, D C, U S Government Printing Office, pp 226-242, 1968. 17 p, 2 fig, 1 tab.

Descriptors: *Water quality, *Water management, *Institutions, *Pacific Northwest U S, Resource allocation, Effluents, Estuarine environment, Decision-making, Benefits, Legal aspects.
Identifiers: *Resource use planning, *Inter-industry sectors, *Yaquina River, External effects, Common ownership, Economic development.

This is a discussion of both a procedure for estimating economic values associated with alternative resource use patterns as well as the process of incorporating these alternatives into the existing resource management institutions. With appropriate modifications the adoption of this procedure is possible in any region of the world. The specific steps are as follows: (1) at the outset-identification and specification of all alternatives; (2) the inclusion of technical measures associated with every related discipline, (3) an appreciation of the degree of common ownership and external effects, and therefore the need for public participation; (4) the derivation of local secondary effects to fully appreciate the magnitude of the economic results of each alternative; (5) the establishment of a continuing data collection and utilization scheme; (6) the characterization of the existing water laws as related to the alternatives considered; (7) the evaluation of existing public water management units to determine the appropriate location and form of the derived management process; (8) the resolution of economic solutions and institutional receptivity to these solutions to determine either the economic alternative acceptable within the present institutional framework, or the institutional modification required to enact a given resource use plan. (Sokoloff-Rutgers)
W69-06725

REGIONAL PLANNING FOR WATER DEVELOPMENT IN THE WESTERN UNITED STATES - THE RELEVANCE OF AMERICAN EXPERIENCE FOR OTHER NATIONS,
Ernest A. Engelbert.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, Washington, D C, U S Government Printing Office, pp 256-268, 1968. 13 p, 2 fig.

Descriptors: *Water supply, *Long-term planning, *Multiple purpose projects, Irrigated land, Hydroelectric power, Municipal water, Federal government, Water distribution, Inter-basin transfers, Urbanization, Pricing.
Identifiers: *Western United States, *Water resources planning, Basin account.

Many other nations of the world are faced with some of the same conditions of water development that confront the Western United States. With the aid of hindsight, some conclusions may be drawn from American experience which may have relevance for countries which are moving forward with major water resources programs. The implication, however, should not be drawn from this that the United States does not likewise benefit from the accomplishments of other lands. Indeed, from the beginnings of irrigation to modern-day pollution control, the United States has drawn much from the experiences and practices of foreign cultures. Looking to the future, much exchange of information and knowledge will have to take place continuously among all nations, if the water resources needs of the world's populations are to be met. However, not until most Western water developments had taken shape could meaningful conclusions concerning desirable and undersirable trends be reached. (Sokoloff-Rutgers)
W69-06726

PLANNING AND DEVELOPMENT OF WATER RESOURCES IN INDIA,
K. L. Rao.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 7, Washington, D C, U S Government Printing Office, pp 390-402, 1968. 13 p.

Descriptors: *River systems, *Water resources development, Storage capacity, Hydroelectric power, Groundwater, Irrigation, Flood control.
Identifiers: *Rainfall pattern, *Surface flows, Tubewells.

In India, the supply of water to land is not adequate. Out of a cultivated area of 158 million hectare, only about 23 percent is irrigated. With such low density of water supply, a tropical country cannot raise sufficient food-grains to feed a vast and thickly populated country like India. An adequate number of irrigation projects to supply water to at least 50 percent of the cultivated area have to be executed. Another reason for water supply is that rice, the main staple grain grown and used in India, is a plant which needs irrigation. Hence India's first and foremost need is the maximum possible extension of water supply. Hydroelectric power generation in India has a great future. Only 10 percent out of the total potential of 41 million kw, has been developed up to the end of the third plan. There is, therefore, ample scope for future development. (Sokoloff-Rutgers)
W69-06728

KANSAS RIVER BASIN FLOOD CONTROL,
Willia L. Northrop, and Clifford J. Phillips.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 7, Washington D C, U S Government Printing Office, pp 814-834, 1968. 21 p, 8 fig, 3 tab, 7 ref.

Descriptors: *Flood control, *Flood protection, *Water resources development, Irrigation, Water Resources Planning Act.
Identifiers: *Kansas River Basin, *Bureau of Reclamation, *Corps of Engineers, *Electric Flood Model, *Digital computer, Reservoir regulation techniques.

While no one would expect to use a water management plan tailor-made for the Kansas Basin in another area, the principles and experiences can be used in many areas. The fact that planning began prior to full development and has been adjusted to fit basin needs makes it relevant in many ways to problems that will be encountered in undeveloped areas. Hydrologic engineering techniques, project formulation procedures, financing, construction methods, and adjustments necessitated by the projects are all significant factors. Adoption of a complete and practicable master plan for reservoir regulation coincident with the formulation of reservoir projects would be advantageous both to planning and to subsequent regulation of the completed facilities. The digital computer programs and the Electric Flood Model described in the paper could be adopted to flood regulation in many basins with problems quite at variance with the Kansas River Basin. (Sokoloff-Rutgers)
W69-06729

WATER TRANSPORTATION-IMPACT ON ECONOMIC DEVELOPMENT,
Walter J. Willis, and David L. Armstrong.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 7, Washington, D C, U S Government Printing Office, pp 905-915, 1968. 12 p, 18 ref.

Descriptors: *Industrial production, Transportation, Resource allocation, Political aspects.
Identifiers: *Water transportation, *Economic development, Non-destructive use, Market economy, Market structure, Ports, Social attitudes.

The thesis of this paper is that throughout the world the urge of governments, researchers, and the people is economic development. Economic development in itself is extremely slow, often impersonal and very complex. However, the direction given by those involved in economic development provides the conscience of all planning. Economic planning implies growth. It is argued that for this growth to occur there is a need for greater production specialization which can be possible only if there is interregional trade. For such trade to develop, there must be an efficient transportation system. In either a developed or an emerging country, a fully developed water transport system is a valuable asset. Recognizing that an integrated transportation system is important, the relative advantage of water transportation in moving many goods and material of the extractive industries and as an impetus to industrial growth is empirically unquestioned. It is recognized, however, that a developed transportation system is a necessary but not a sufficient factor to assure this economic development goal. (Sokoloff-Rutgers)
W69-06730

ESTIMATION OF RETURNS TO SCALE AND THE ELASTICITY OF SUBSTITUTION,
Stanford Univ., Calif.
G. S. Maddala, and J. B. Kadane.
Econometrica, Vol 35, No 3-4, pp 419-423, July-October 1967. 5 p, 3 tab, 3 ref.

Descriptors: *Returns to scale, Monte Carlo method.
Identifiers: *Elasticity of substitution, *CES production function, production function, Cobb-Douglas production function, Bias, Kmenta's procedure.

This paper concerns itself with the following problem: Suppose the true production function is of the CES type with constant returns to scale. If we fit an unrestricted Cobb-Douglas production function instead, what is the nature of the bias in the estimate of the returns to scale parameter. The authors conclude that under some circumstances a misspecification of the elasticity of substitution, sigma can result in a substantial bias in the estimates of returns to scale. The authors feel that it is preferable to use the Kmenta approximation to the CES function rather than use the Cobb-Douglas production function. Applying Theil's formula for specification errors to the Kmenta approximation helps investigate the direction of the bias. The authors' findings suggest that in the case they investigated where L and K are independently and uniformally distributed, and where the Cobb-Douglas approximation gives a biased estimate of returns to scale, the bias in the estimates of returns to scale obtained by the Kmenta procedure is negligible while the Kmenta estimates of sigma are not reliable. Water supply analysis implicitly is based on economic production theory and thus, this article extends the area of econometric investigations into production function analysis and

may be of relevancy to empirical water research in water supply problems. (Loeb-Rutgers)
W69-06732

COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
California Univ., Berkeley, Calif.
Stephen V. Allison.
Water Resources Center, Contribution No 120, Technical Report 6-27, May 1967. 142 p. OWRR Project A-003-CAL.

Descriptors: *Data collections, *Value, *Mathematical models, Cost allocation, Costs, Statistics, Measurement, California, Planning, Model studies, Computer models, Decision making, Hydrologic data, Ground water basin.
Identifiers: Kern County, Precision, Mathematical decision techniques.

The problem of allocating available resources among the many diverse activities required in water development planning is presented. A method of solution based on mathematical decision techniques is proposed. The conceptual framework on which the proposed method is based depends on the relationship between the cost of the activity and the precision. The degree to which this precision affects the attainment of the overall objectives of the planning program is taken as a measure of the value of precision in each activity. The expression of these cost-precision and values of precision relationships in quantitative terms provides the basis for the application of mathematical decision techniques. The problem may be formulated either in terms of maximizing overall precision subject to a fixed budget constraint, or minimizing the cost of attaining a specified degree of overall precision. (Winn-Rutgers)
W69-06733

ON THE RELATIVE SMALL-SAMPLE PROPERTIES OF SEVERAL STRUCTURAL-EQUATION ESTIMATORS,
British Columbia Univ., Vancouver.
J. G. Cragg.
Econometrica, Vol 35, No 1, pp 89-110, January 1967. 22 p, 10 tab, 19 ref.

Descriptors: Estimating, Estimating equations, Least squares method, Regression analysis, Monte Carlo method.
Identifiers: *Small-sampling properties, Structural-equation estimators, *Estimators, Direct least squares, Two-stage least squares, LIML, FIML, Bias.

This paper reports on the results of some sampling experiments on six structural-equation estimators: direct least squares, two-stage least squares, Nagar's unbiased K-class estimator, limited-information maximum likelihood, three-stage least squares and full-information maximum likelihood. Sensitivity of the relative performances of the estimators to the parameter values chosen in the models and to the values of the exogenous variables is studied. It is found that differences among the estimators are not great and that they are sensitive to the parameters used. In light of the extensive use of stochastic econometric estimating techniques in problems dealing with water research, this article presents some interesting comparisons between estimation methods that will be of relevancy to empirical water research studies. (Loeb-Rutgers)
W69-06734

CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS IN ECONOMICS,
Australian National Univ., Canberra.
E. J. Hannan.
Econometrica, Vol 35, No 1, pp 123-138, January 1967. 16 p, 5 ref.

Descriptors: Economics, Regression analysis.
Identifiers: *Canonical correlation, *Multiple equation systems, LISE, Estimation, Two-stage least squares, Three-stage least squares, Identification.

The LISE technique is extended to deal with certain subsystems of a full system which are of a special type. It is shown that any completely identified system can be uniquely decomposed into maximal subsystems of this type. The relation of the estimation procedure to certain classical statistical estimation procedures is discussed. The use of limited information simultaneous equation methodology may be of relevance to the researcher dealing in water problems when complete or simultaneous econometric models are used to represent the water market or system. (Loeb-Rutgers)
W69-06735

THE ROLE OF ALTERNATIVE COST IN PROJECT DESIGN AND SELECTION,
Wisconsin Univ., Madison.
Peter O. Steiner.
Quarterly Jour of Economics, Vol 79, No 3, pp 417-430, August 1965. 14 p.

Descriptors: *Alternative costs, Benefits, Costs.
Identifiers: *Project design, *Project selection, Public expenditures, Benefit measurement, Public project, Private project, Choice, Government action.

In this article the author addresses the problem of under what conditions can we avoid, limit, or make more manageable the difficult problem of benefit estimation. It is assumed throughout the paper that it is easier to evaluate the cost of anything than to estimate the benefits that accrue therefrom. As such, the central question here addressed is when and to what extent can the cost of an alternative project substitute for or provide limits to benefit measurement. The author finds that in some cases alternative costs substitute for benefits, in others they provide upper limits to benefits, and in still others they provide minimum target levels that benefits must reach for choices that have to be made. The problem is complicated because a specific proposed public project may have differing alternatives. The basic strategy of this paper is to set up what appears to be a limited model which considers only two public projects and two private projects. By varying assumptions about: (1) what is alternative to what; (2) what combinations of projects are compatible; (3) what institutional rules govern the selection of projects; (4) what quantities and qualities of services are provided by individual projects, we can capture the flavor of many possibilities of the general problem, and define the extent to which alternative costs substitute for benefit measurement. (Loeb-Rutgers)
W69-06738

THE OPPORTUNITY COSTS OF PUBLIC INVESTMENT,
Harvard Univ., Cambridge, Mass.
Stephen A. Marglin.
Quarterly Jour of Economics, Vol 77, No 2, pp 274-289, May 1963. 16 p, 2 fig.

Descriptors: Discount rate, Pricing, Marginal productivity, Investment, Planning, Return.
Identifiers: *Opportunity cost, *Public investment, Shadow pricing, Marginal rate of time discount, Marginal social rate of discount, Private investment, Consumption.

This essay builds on the results of a previous article in exploring the implications for public investment planning of departures of the marginal productivity of private investment from the marginal rate of time discount appropriate for evaluating investment from the social point of view. The world assumed is one in which the marginal social rate of discount is less than the marginal productivity of private investment. In addition it is assumed that the government is unable to drive the marginal productivity of investment all the way down to the marginal social rate of discount by direct means or by indirect means. Public investment nevertheless competes with private investment as well as with private consumption for resources. In such a world the market undervalues resources earmarked for investment, and the interdependence of the levels of public and private investment obliges us to take this undervaluation into account in the planning of public investment. In this essay three methods--each appropriate under particular assumptions about reinvestment of returns--are proposed for evaluating a 'shadow price' of public investment funds that reflects the value at the marginal social rate of discount of the alternative use of funds in the private sector. This article has important ramifications for water projects involving the questions of social discount rates and public investment decisions. (Loeb-Rutgers)
W69-06739

CHOOSING AMONG ALTERNATIVE PUBLIC INVESTMENTS IN THE WATER RESOURCE FIELD,
Wisconsin Univ., Madison.
Peter O. Steiner.
AER, Vol 49, No 5, pp 893-916, December 1959. 24 p, 4 tab, 8 ref, 1 append.

Descriptors: *Water resources, Investment, Water resources development, Benefits, Costs, Marginal benefits, Marginal costs, Performance, Welfare.
Identifiers: *Public investment, Restraint, Opportunity costs, Objective function.

The problem of choosing among alternative public expenditures with particular reference to water resource development is discussed. As a classical problem in efficient resource allocation, there is a solution that is simple and well known. In a determined model the appropriate policy is to build every project for which benefits exceed costs and to develop every project to the point where marginal benefits equal marginal costs. There are several reasons why this solution is not satisfactory and which together make the choice of the best possible program a complex one which no simple marginal equivalence can handle. An operational framework is presented for choosing efficient programs subject to appropriate budget restraints, incompatibility restraints, and discreteness restraints while recognizing the full range of opportunity costs of any action. A model is developed which suggests how to assign a numerical value to every potential project so that it may be directly compared with every other project. Thus, the program may be chosen that will maximize the appropriate welfare criterion subject to all appropriate restraints. (Loeb-Rutgers)
W69-06740

DESALTED SEAWATER FOR AGRICULTURE: IS IT ECONOMIC,
Resources for the Future, Inc., Washington, D. C.
For primary bibliographic entry see Field 03F.
W69-06765

WATER FOR TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
J. R. Runkles.
Proc 13th Annu Conf on Water for Texas, Nov 25-26, 1968, Texas A and M Univ, 1968. 72 p, 22 fig, 6 tab, 39 ref.

Descriptors: *Planning, *Water resources development, *Texas, Systems analysis, Operations research, Water reuse, Data storage and retrieval, Water conservation, Desalination, Electrophoresis.
Identifiers: Texas water planning, Texas Water Development Board.

The 13th Annual Water for Texas Conference, 1968, was held to focus attention on the water needs of Texas, methods of determining and projecting needs, and methods of planning solutions for water problems. Topics of the papers in the

conference include operations research, systems analysis, water treatment by electrophoresis, and conservation of water. Plans of the Texas Water Development Board, the Corps of Engineers, and the Bureau of Reclamation are outlined. Information storage and retrieval services provided by the Department of Interior Water Resources Scientific Information Center are included. (Knapp-USGS)
W69-06790

CHESAPEAKE BAY CASE STUDY.
Trident Engineering Associates, Inc., Annapolis, Md.

Trident Eng Ass Inc, Sept 1968. 131 p, 56 ref. Available from Clearinghouse as PB 179 844 at $3.00 in paper copy and $0.65 in microfiche.

Descriptors: *Water quality, *Water utilization, *Water policy, *Maryland, *Virginia, Estuaries, Administration, Governments, Water law, Planning, Recreation, Regulation, Fishing, Navigation, Water pollution control.
Identifiers: *Chesapeake Bay.

The policies of the Maryland, Virginia, and U.S. Governments on the use, development, and pollution control of the Chesapeake estuary, and the effects of present use and policies on water quality are surveyed. There is no State control of water development and pollution abatement, but both states leave control to individual counties, which have no integrated, uniform, or consistent policies. State and Federal matching funds and grants encourage long-range planning, but do not have provision for certification by state or regional planning agencies. Some Federal statutes, particularly urban renewal statutes, even encourage local, municipal, or neighborhood control. Coordination of local plans is needed, as well as the establishment at a regional planning agency, if the quality of the area is to be maintained. A combined Federal-State-local agency for planning, enforcement, construction, and regional regulation of development of Chesapeake Bay in water quality, marine life, erosion control, commerce, zoning, parks, recreation, and fishing is recommended. (Knapp-USGS)
W69-06794

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
Resources for the Future, Inc., Washington, D. C.; and Johns Hopkins Univ., Baltimore, Md.
For primary bibliographic entry see Field 06D.
W69-06502

PUBLIC UTILITY PRICING AND OUTPUT UNDER RISK,
Washington Univ., Seattle; and California Univ., Santa Barbara.
Gardner Brown, and Bruce Johnson.
American Economic Review, Vol LIX, No 1, pp 119-128, March 1969, 6 fig, 8 ref.

Descriptors: *Pricing, *Welfare (Economics), Risks, Public utilities, Demand.
Identifiers: Output, Riskless demand, Stochastic demand.

Most contributors to the theory of publicly produced private goods contend that any public authority that produces and sells a private good will discharge its responsibility in an optimal manner when it acts as if it were a competitive industry and prices at marginal cost. The purpose of this paper is to introduce elements of risk into the analysis. The authority is assumed to be confronted by a product demand function subject to a stochastic disturbance term. The social welfare function that the authority maximizes is the algebraic difference between expected willingness to pay and expected costs. It is concluded that the optimal price will always be lower and, with linear demand, the optimal output will generally be higher than their counterpart in the riskless model of traditional theory, regardless of the manner in which the disturbance term enters the analysis. The implication is that the authority will fail to recover its capital or capacity costs unless the environment includes perfect risk markets. This article has relevancy to important pricing decisions in the marketing of water by public agencies. (Winn-Rutgers)
W69-06549

HOUSEHOLD PRODUCTION AND CONSUMER DEMAND FUNCTIONS,
Chicago Univ., Ill.; and Institute for Defense Analyses, Arlington, Va.
For primary bibliographic entry see Field 06D.
W69-06566

CONSUMER ASPECTS OF PRICE INSTABILITY,
Department of Agriculture, Washington, D. C.
Frederick V. Waugh.
Econometrica, Vol 34, No 2, pp 504-508, April 1966. 5 p, 2 fig, 7 ref.

Descriptors: Prices, Pricing, Stability, Average.
Identifiers: *Price instability, *Price stability, Producers, Consumers, Index number.

Recent papers in Econometrica discussed price instability vs. price stability from the standpoint of producers. Oi demonstrated that the producer of any good could make more profits when the price of that good varied than he could if prices were stabilized at their arithmetic mean of the varying price. Tisdell showed that if output could not be adjusted, but must be rigidly preplanned, the producer could make greater profits with a fixed price than with a varying price with the same average. Zucher concluded that if the elasticity of supply is constant, and if revenue, rather than price, is stabilized, producers lose nothing, and may well gain, since fluctuating prices may require additional costs to manage output efficiently. The present author has previously shown that a consumer is better off with varying prices than with prices stabilized at or above their simple unweighted arithmetic mean. Howell and Lovasy demonstrated that a consumer is worse off with varying prices than with prices stabilized at or below their unweighted mean. This paper presents simple graphic proofs of these conclusions. This article is relevant to the pricing policy decisions of water suppliers with significant implications for both water consumers and producers. (Loeb-Rutgers)
W69-06570

OPTIMALITY OF IMPERFECTLY COMPETITIVE RESOURCE ALLOCATION,
Case Western Reserve Univ., Cleveland, Ohio.
Josef Hadar.
Western Economic Journal, Vol 7, No 1, pp 51-56, March 1969. 6 p, 7 ref.

Descriptors: *Resource allocation, Monopoly.
Identifiers: *Optimality, *Pareto-optimality, *Imperfect competition, Pareto-optimal distribution, Exchange model.

The author considers an exchange model in which a monopolist sets all market prices. The formulation of this model has given rise to a non-tatonnement process without recontracting in which the price setter is motivated exclusively by his own interest. However, since the competitive traders will engage in exchange only if it will not bring about a deterioration in their own positions, every trader's level of utility becomes a monotomically increasing function of time. It also turns out that so long as there exists a Pareto-superior distribution, the monopolist can raise his own level of utility, so that the process will not converge before a Pareto-optimal distribution is reached. The author concludes that the pure exchange models are not the most general type of resource allocation models, but the distribution of fixed quantities of goods among a number of sellers and buyers is a legitimate economic function which is performed by numerous markets. Hence, the establishment of the optimality properties of such trading processes under different market structures is of some significance. The author suggests that this line of inquiry should be pursued in order to see to what extent the results of this paper must be modified by the introduction of consumption and production. The problems of pricing, water-market structures and benefit measures as related to water projects are the relevant areas treated by this article as it applies to water research. (Loeb-Rutgers)
W69-06722

COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
California Univ., Berkeley, Calif.
For primary bibliographic entry see Field 06B.
W69-06733

THE ROLE OF ALTERNATIVE COST IN PROJECT DESIGN AND SELECTION,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 06B.
W69-06738

THE OPPORTUNITY COSTS OF PUBLIC INVESTMENT,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 06B.
W69-06739

CHOOSING AMONG ALTERNATIVE PUBLIC INVESTMENTS IN THE WATER RESOURCE FIELD,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 06B.
W69-06740

6D. Water Demand

ESTIMATED WATER USE IN NEVADA, 1950-65,
Geological Survey, Carson City, Nev., and Nevada State Dept. of Conservation and Natural Resources.
J. R. Harrill, and G. F. Worts, Jr.
Nev State Dep Conserv and Natur Resources - Div of Water Resources Inform Ser Rep 7, 1968. 37 p, 2 fig, 14 tab, 21 ref.

Descriptors: *Water utilization, *Data collections, *Nevada, Surface waters, Groundwater, Irrigation, Industrial water, Municipal water, Irrigation water, Consumptive use, Water management (Applied).
Identifiers: Water use (Nev).

Estimated withdrawal use from streams and groundwater in Nevada increased from about 1.8 million acre-ft in 1950 to about 2.3 million acre-ft in 1965. Use of surface water increased from 1.6 to 1.8 million acre-ft during this period, whereas use of groundwater (pumpage and springflow) increased from 190,000 to 540,000 acre-ft. The largest single use increase was in pumpage for irrigation--from about 30,000 acre-ft in 1950 to 290,000 acre-ft in 1965. Irrigation use from streams and groundwater in 1965 accounted for 2.1 million acre-ft, or 93% of the total withdrawals. Most of the surface-water resources already have been developed fully. Thus, little increase usage can be expected to occur in the future, and most of the future increased demand, except for diversions from the Colorado River, probably will be provided by groundwater. During the period 1960-65 groundwater use increased as follows: irrigation 37% public supply 40%, industrial self-supplied 10% and rural use 60%. (Knapp-USGS)
W69-06446

OPERATION OF MULTI-UNIT MULTI-PURPOSE WATER DEVELOPMENT SYSTEMS,
University of the Witwatersrand, Johannesburg (South Africa).
D. C. Midgley.
Int Conf on Water for Peace, Wash, D C, Vol 8, pp 160-169, 1968. 10 p, 7 fig, 1 tab, 5 ref. For the 8 Volume Proc, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *Multiple purpose projects, *Optimum development plans, *Water distribution (Applied), *Water resources development, *River basin development, Watershed management, Water storage, Flood control, Hydroelectric power, Irrigation, Recreation, Administration, Management, Meteorology, Water demand.
Identifiers: *South Africa, Multi-unit system.

Centers of water demand and sources of water supply can be viewed as comprising a complex system of multiple storage units connected both to each other and to demand centers by natural channels and artificial conduits. Inputs to a unit of the system take the form of natural river flow, return flow of reclaimed water and gravity or pumped supplies from other units. Outputs from a unit comprise net evaporation losses, withdrawals for multiple uses, including the augmentation of supplies to other units of the system. The advantages to be gained in areas of erratic river flow by combining within a system many different types of demand having widely varying growth rates, seasonal fluctuations and degrees of required assurance of supply are shown and the economies that can be effected by combining, in a single system, supply sources lying in different meteorologic regions are discussed. With examples drawn from possible interconnections of South African watersheds, it is shown that by integrating several river systems to form a single multi-unit system, extremely low total flows within the system will be found to be very infrequent. The concept of the water grid, analogous to the power grid is developed and shown that a given demand configuration can be satisfied from a system of interconnected watersheds with greater security, with a smaller total volume of storage and with lower water losses than from a series of independent units. (Knapp-USGS)
W69-06462

THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
Resources for the Future, Inc., Washington, D. C.; and Johns Hopkins Univ., Baltimore, Md.
Charles W. Howe, and F. P. Linaweaver, Jr.
Water Resources Res, Vol 3, No 1, pp 13-32, 1st Quarter 1967. 20 p, 5 tab, 23 ref.

Descriptors: *Water demand, *Economics, *Regression analysis, *Domestic water, *Pricing, Sprinkling, Spatial distribution, Temporal distribution, Elasticity of demand, Design data, Mathematical models.
Identifiers: Residential water demand, Metered, Flat-rate.

Models of residential water demand were structured, with parameters estimated from multi-city cross-sectional data by regression analysis. Demand was differentiated between domestic (inside) and sprinkling use, and also between metered, flat-rate, septic tank and apartment areas. The major findings were: (1) domestic demands were relatively price inelastic; (2) sprinkling demands were price elastic, but less so in the U. S. west than in the east; (3) maximum day sprinkling demands were inelastic in the west but relatively elastic in the east. The weighted average elasticity of total demand was found to be about -0.4. Longer term adjustments to price were empirically investigated, and the role of demand functions in pricing and system design was discussed. (Gysi-Cornell)
W69-06502

HOUSEHOLD PRODUCTION AND CONSUMER DEMAND FUNCTIONS,
Chicago Univ., Ill.; and Institute for Defense Analyses, Arlington, Va.
Richard F. Muth.
Econometrica, Vol 34, No 3, pp 699-708, July 1966, 10 p, 9 ref.

Descriptors: Elasticity of demand, Income, Prices.
Identifiers: *Household production, *Consumer demand function, Price index.

This paper considers the hypothesis that commodities purchased on the market by consumers are inputs into the production of goods within the household. Its implications for the family of consumer demand functions whose arguments are real income and relative prices are drawn and compared with those of the hypothesis of additive separability. The paper closes with some examples of differences in commodity demand elasticities which are qualitatively consistent with the household production hypothesis and some comments upon how the latter might be utilized in empirical work. The article is relevant to water demand research were as in this article water can be treated as an input into the production of goods within the household. (Loeb-Rutgers)
W69-06566

THE COMPETITION FOR WATER QUALITY: RECREATION,
Associated Sportsmen of California, San Francisco.
James F. McCormick.
For main entry see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 65-67, January 11-13, 1961. 3 p.

Descriptors: *Recreation, Water allocation (Policy), Water quality, Water utilization, California.

During a major portion of California's history, recreational use of the water supplies has received little or no attention. The 'little orphan' attitude adopted towards such use was justified at the turn of the century on the basis that recreational water use and recreation played a minor part in the state's overall economy. Recently recreationists and sportsmen have made progress in obtaining legal recognition of the principle of recreation as a beneficial water use. They realize that progress cannot and must not be impeded. However, they also realize that recreation, as an important industry, must be given a fair and judicial allocation in the competition for water quality and use. (Winn-Rutgers)
W69-06573

THE COMPETITION FOR WATER QUANTITY,
Bureau of Reclamation, Sacramento, Calif.
H. P. Dugan.
For main entry see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 76-78, January 11-13, 1961. 3 p.

Descriptors: *Water demand, Water allocation (Policy), Water rights, Water supply, California, Water utilization, Competing uses.

The past history of competition for water quantity reveals the evolution from competition among individual users, usually agricultural, to competition between a large municipal user and an agricultural area, to competition between states, and finally to competition between nations. In resolving these conflicts, agreements appear to show a trend towards apportioning waters before a critical use problem develops by means of compacts and operating agreements. Water uses that are complementary form the basis for resolving future competition into potential projects. In the short run water use may appear to be competitive among agricultural, municipal, industrial and recreational users. However, if the frame of reference is big enough, competition in one area can be complementary to an adjacent area. (Winn-Rutgers)
W69-06574

THE COMPETITION FOR WATER QUANTITY: AGRICULTURE,
Feather River Project Association, Bakersfield, Calif.
Allen Bottorff.
For main entry, see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 79-83, Jan 11-13, 1961. 5 p, 2 ref.

Descriptors: *Agriculture, *Water allocation (Policy), *California, Water policy, Water supply, Groundwater, Value.
Identifiers: Agribusiness, California Water Bond Act.

A US Senate Select Committee Report has concluded that agricultural water withdrawals and consumption from rivers and streams in California may be expected to decline, while withdrawals and consumptive uses may be expected to increase for other purposes. However, because the report does not consider California's groundwater resources, its conclusion may not be valid. Farmers should receive special attention from policy makers in the competition for water. Farming helps to support whole industries and a vast number of workers in those industries. One team of economists has estimated that 37% of the national working force is employed on the farm and in associated industries essential to growing, preparing and delivering farm products. (Winn-Rutgers)
W69-06575

COMMENTS ON THE COMPETITION FOR WATER QUALITY: AGRICULTURE,
Sierra Club, San Francisco, Calif.
David R. Brower.
For main entry see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 84-87, Jan 11-13, 1961. 4 p.

Descriptors: *Natural resources, Resources, Water resource development, Withdrawal.
Identifiers: Renewable resources, Non-renewable resources.

It has been customary to view each natural resource as being renewable, such as foods and fibers, or as being non-renewable, such as minerals and fossil fuels. Rather than considering how renewable a resource is, consideration should be given to the prospects of finding a substitute for it. This is so for two reasons; (1) Our rate of depletion of the non-renewables is accelerating and (2) Our renewables depend entirely upon the earth's thin skin of soil and this soil is being wasted at a rapidly increasing rate. Prospects are good for finding substitutes for the non-renewable resources through improved technology. Prospects are not as good for finding substitutes for the forms of life in the soil, on the land and in the air. (Winn-Rutgers)
W69-06576

THE COMPETITION FOR WATER QUANTITY: INDUSTRY,
West Basin Municipal Water District, Hermosa Beach, Calif.
Carl Fossette.
For main entry see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 88-96, Jan 11-13, 1961. 9 p.

Descriptors: *Water allocation (Policy), *Water supply, *California, *Water management (Applied), Industrial water, Water conservation, Ground water, Water reuse, Water rights, Water quality.
Identifiers: West Basin Water Association, Central Basin Water Association, Los Angeles Flood Control District, California Water Plan.

Although a strong case could be made for industry in competition with other users for its share of the available water resources, this article tries to show the futility of any program directed toward the assignment of water priorities. Such a program would place each user in competition with all other users and would probably lead to wholesale litigation and

eventual rationing of the available supply. This would be inconsistent with a balanced economy and would retard the development of new sources of supply. It is suggested that rather than compete for water, users should recognize that water is no longer virtually free and that it will require human energy and much money to furnish it in requisite quantities where needed. (Winn-Rutgers)
W69-06577

THE COMPETITION FOR WATER QUANTITY: RECREATION,
California Dept. of Fish and Game, Sacramento.
Walter Shannon.
For main entry see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 112-115, Jan 11-13, 1961. 4 p.

Descriptors: *Recreation, Water resource development, California, Water demand, Planning, Water policy.

A three year study of California recreation indicates that 69 percent of all outdoor recreation is centered around water. Water development is an essential and continuing process of civilization. However, well-planned water developments which recognize fish and wildlife as a beneficial use of water can provide for perpetuation of these valuable resources at reasonable costs without seriously encroaching on other uses of that water. The public is looking more and more to water developers to recognize and accept some responsibility in developing recreational opportunities and facilities as part of water projects. Consequently, state, federal, local governments and many private developers are coming to recognize the importance of providing for recreation. (Winn-Rutgers)
W69-06578

CONSERVATION'S CHALLENGE TO STATE GOVERNMENTS,
For primary bibliographic entry see Field 06E.
W69-06586

GREAT LAKES COMPACT (AGREEMENT FOR EFFICIENT MANAGEMENT OF THE GREAT LAKES BASIN).
For primary bibliographic entry see Field 06E.
W69-06616

FORECASTING URBAN WATER DEMANDS IN DEVELOPING COUNTRIES,
Edward A. Bryant.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 7, Washington D C, U S Government Printing Office, pp 1-9, 1968. 9 p, 3 fig, 2 tab, 3 ref.

Descriptors: *Urbanization, *Forecasting, *Water demand, Natural resources, Industrial water, Domestic water, Distribution systems, Weather.
Identifiers: *Population trends, Commercial water, Metering, Unaccounted for water.

A large portion of the world suffers from water shortages. The major causes are (1) lack of natural resources, (2) lack of financing and proper management, and (3) limited water handling facilities. In the latter case the goal of the water-supplying agency should be to meet all demands. 'Demand' is considered to be the amount of water which would be used if it were available at a reasonable cost. The necessary advanced planning to meet all demands requires a reliable estimate of future water demands components of total demand, i.e., domestic, commercial, industrial demands for water are affected by many conditions. Each of these components and the conditions which affect them must be analyzed to obtain a reasonably accurate forecast of water demand. This paper describes the components of demand and some of the conditions which affect them. It also provides data which may be used to determine future water demands. (Sokoloff-Rutgers)
W69-06727

WATER FOR TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 06B.
W69-06790

6E. Water Law and Institutions

INTERGOVERNMENTAL PLANNING OF WATER RESOURCES,
Water Resources Council, Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-06429

SAFETY CONTROL OF PRIVATE DAMS,
New England River Basins Commission, Boston, Mass.
For primary bibliographic entry see Field 04A.
W69-06433

RURAL WATER DEVELOPMENT IN KENYA,
Department of Water Development (Kenya).
For primary bibliographic entry see Field 04A.
W69-06453

THE ROLE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IN THE DEVELOPMENT, USE AND CONTROL OF WATER RESOURCES.
International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 03A.
W69-06456

BENEFICIAL USES OF WATERS OF INTERNATIONAL RIVERS: INTERNATIONAL LAW AND PRACTICE,
Ministry of Irrigation and Power (India).
P. R. Ahuja, and D. L. Kamat.
Int Conf on Water for Peace, Wash, D C, Vol 5, pp 584-590, 1968. 7 p, 13 ref. For the 8 Volume Proc, see Vol 2, No 9, Field 06B and W69-03305.

Descriptors: *International law, *River basins, *Beneficial use, *Riparian waters, International Bound and Water Comm., Boundary disputes, Water law, Appropriation, Treaties.
Identifiers: *International rivers, Territorial sovereignty.

Theory and practice agree that rivers are part of the riparian State. Territorial sovereignty of States extends as much to land within the respective boundaries as to waters flowing on the land, and practice so far shows that States generally regard all legal questions concerning State territory as internal jurisdiction. No generally recognized rules exist in International Law today which can determine what should be the legitimate shares of co-riparian States in the beneficial uses of international rivers. Moreover, State practice in the past 50 years shows there are no general rules to govern all international river problems. Each river has its own individuality, and individual problems must be solved by treaty. In the absence of treaty limitations, the only limitation to a State's sovereign right over the waters of an international river flowing through its territory is the general limitation against 'abuse of rights'. The facts of each case would establish liability. Even without treaties governing specific river problems, the riparian States can cooperate for mutual benefit in prevention and control of floods, cooperation in flood forecasts and flood warnings, exchange of meteorological and rainfall data, etc. (Vorhis-USGS)
W69-06458

CIVIL ENGINEERING AND URBAN SYSTEMS,
Northwestern Univ., Evanston, Ill.
For primary bibliographic entry see Field 06A.
W69-06491

THE INFLUENCE OF OWNERSHIP AND CONTROL ON PROFIT RATES,
Missouri Univ., Columbia.
For primary bibliographic entry see Field 06B.
W69-06545

LEGAL ALTERNATIVES,
William H. Jennings.
For main entry see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 122-126, Jan 11-13, 1961. 5 p.

Descriptors: *Legal aspects, *Water resource development, Water rights, Riparian rights, Water law, Governments, Federal government, State governments, Prior appropriation, Water policy.
Identifiers: Public interest, Federal-state rivalry.

The history of the development of water law in California has been a struggle to adjust the concept of the ownership and use of water as a simple matter of property to the broader concept of the public interest in its control and development. The entry of big government into the field of water resource development has forced us to review our system of water law. We have been forced to consider water development and control as an instrument of social reform and as a tool for economic adjustment. Perhaps the most serious result of big water-project development is the growing rivalry between state and federal governments as to which shall be in control of the projects. (Winn-Rutgers)
W69-06579

THE LEGISLATIVE POINT OF VIEW,
Richard Richards.
For main entry see Field 06B, W69-06572.
Proceedings of Conference at University of California at Davis, pp 135-139, Jan 11-13, 1961. 5 p.

Descriptors: *Legislation, *Water resource development, Political aspects, Government, California.
Identifiers: Public opinion.

Legislators, no matter how long they have worked with water problems, are not water experts. The water experts should be allowed to control the water development of California. The avalanche of bills in the state legislature represents a threat to the control of water development by the professionals. This does not mean that there isn't room for constructive legislation designed to augment and facilitate the water program. Water experts should actively try to mold public opinion and thereby influence legislation. Even though a legislator has a natural tendency to want to be popular in his home district, he must consider the interest of the state as a whole. (Winn-Rutgers)
W69-06580

COLEMAN V SCHAEFFER (OBSTRUCTION TO NAVIGABLE STREAM).

163 Ohio St 202, 126 NE 2d 444-449 (1955).

Descriptors: *Ohio, *Navigable waters, *Lake Erie, *Streams, Bridges, Marinas, Legislation, Rivers and Harbors Act, Judicial decisions, Stream fisheries, Flotation, Vegetation effects, Streamflow, Boats, Access routes, Legal aspects, Lakes, Remedies.
Identifiers: *Injunctions (Mandatory), Ingress, Egress.

Plaintiffs brought suit for mandatory injunctions to require defendants to remove steel cables and a wire fence from a stream used by plaintiffs in its boat rental business. Defendants owned land on opposite sides of the stream extending up stream from Lake Erie, and plaintiffs' land was immediately above these properties. Defendants' construction of the fence and cable destroyed plaintiffs' right to travel to and from the navigable lake. The lower courts had denied injunctive relief. On appeal, the supreme court noted that the ultimate question to be decided was whether this stream was a navigable

stream. The court indicated that the lack of commercial traffic does not necessarily indicate the stream is non-navigable. A stream is 'navigable' as long as it is capable of being put to any beneficial public use. Although this stream was crossed by a bridge which had a clearance of but 5 1/2 feet, and although it was often clogged with vegetation, plaintiffs operated their boat rental business for 14 years until stopped by the fence and cables. The court was of the opinion that the stream was navigable and that plaintiffs were entitled to the injunctions prayed for. (Reed-Fla)
W69-06584

CONSERVATION'S CHALLENGE TO STATE GOVERNMENTS,
William E. Richards.
Journal of Soil and Water Conservation, Vol 17, No 1, pp 8-10, Jan-Feb 1962. 3 p.

Descriptors: *State governments, *Federal government, *Administrative agencies, *Water resources, Development, Water conservation, Forest management, Land resources, Land reclamation, Preservation, Natural resources, Flood control, Flood protection, Legislation, Administration, Streams, Irrigation, Navigable rivers, Legal aspects, Financing.

Most resource development programs are funded and managed by the federal government. Public programs concerned with forested land, irrigation districts, navigable rivers, and flood control problems are administered by the United States Forest Service, the Bureau of Reclamation, and the United States Army Corps of Engineers. This concentration of administrative power is not conducive to the maintenance of efficient conservation programs, and state governments must develop local agencies competent to accept primary responsibility in vital conservation programs. These suggested state agencies should immediately inventory the classes of land within the state. Such an inventory should include an evaluation of the available water supply, including a projection of future industrial, municipal, agricultural, and navigational needs of the state. Corrective legislation is necessary to create these state agencies, and revenue allocated to these agencies and their programs should be greatly increased. (Katz-Fla)
W69-06586

TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMM'N (PIPELINES ACROSS NAVIGABLE CHANNELS).
293 F Supp 1019-1025 (E D La 1968).

Descriptors: *Channel improvement, *Louisiana, *Pipelines, *Dredging, Navigable waters, Channels, Pipes, Excavation, Right of way, Eminent domain, Harbors, Federal government, State governments, Judicial decisions, Damages, Remedies, United States, Administrative agencies, Costs, Legal aspects.
Identifiers: Third party beneficiary.

Plaintiff gas company in obtaining the rights to lay a pipeline under a navigable channel, agreed with both state and federal agencies to pay the cost of adjusting its pipeline should such adjustment become necessary to some future date. Later, plaintiff sued to recover the cost of lowering the pipeline, an action necessitated by the dredging and deepening of the channel by defendant port commission. The court held for the defendant, finding that the port commission was the beneficiary of the earlier agreement with the state agency. The plaintiff had done no more than it had agreed to do as a precondition to laying the pipeline, and no recovery was justified. The court also noted that because of the substantial federal grant-in-aid supporting plaintiff's operation, the dredging project could be considered the beneficiary of plaintiff's agreement with the federal agency. (Gabrielson-Fla)
W69-06587

BARBER PURE MILK CO V GOLDIN (SURFACE DRAINAGE).

218 So 2d 409-413 (Miss 1969).

Descriptors: *Mississippi, *Surface drainage, *Dairy industry, *Drainage water, Ditches, Water pollution, Contracts, Milk, Cleaning, Public health, Sanitation, Public rights, Insects, Mayflies, Insect attractants, Regulation, Legal aspects, Real property, Land tenure, Cities, Judicial decisions, Legislation, Local governments.
Identifiers: Contracts of sale, Restrictive covenants.

Plaintiff brought action for rescission of a contract to purchase real estate, alleging that the restrictive covenants affecting the property imposed a greater burden than the municipal ordinances. The plaintiff intended to construct a milk processing plant. The cleaning operations would require 25,000 gallons of water daily which the plaintiff proposed to dump in a ditch running across the land. The water would contain some milk residue. The court found that the plaintiff could operate in a manner which would not violate any municipal ordinance but which, nevertheless, would subject it to suit for violation of the covenants. On this basis, the court held the title to be unmerchantable and rescinded the contract. (Stewart-Fla)
W69-06588

RUSSELL V STATE (ILLEGAL POSSESSION OF UNDERSIZED FISH).

220 So 2d 334-340 (Miss 1969).

Descriptors: *Mississippi, *Commercial fishing, *Administrative agencies, *Fish management, Trapping, Regulation, Judicial decisions, Catfishes, Fish conservation, State governments, Freshwater fish, Lakes, Boats, Legal aspects.
Identifiers: *Criminal law, Penalties (Criminal).

Defendant was convicted of possession of undersized catfish. He pleaded guilty when arrested by game wardens after gathering the undersized fish from illegal traps. The court found that the state Game and Fish Commission had legislative authority to make rules and regulations necessary to carry out the provisions which created the Fish and Game Commission. The Commission promulgated regulations which prohibited the possession of catfish under twelve inches in length. Anyone who violates the rules or regulations is guilty of a misdemeanor and shall be fined accordingly. The court upheld the conviction and imposed heavy fines when it was discovered that the defendant was engaged in a commercial venture involving the capture of hundreds of the undersized fish. (Stewart-Fla)
W69-06589

GEORGE V STATE (OBSTRUCTION OF SUBSURFACE FLOW).

205 Misc 992, 130 NYS 2d 8-11 (Ct Cl 1954).

Descriptors: *New York, *Easements, *Percolating water, *Subsurface waters, Judicial decisions, Legal aspects, Condemnation, Eminent domain, Subsurface runoff, Underground streams, Gravitational water, Seepage, Percolation, Subsurface flow, Appropriation, Water wells, Shallow wells, Relative rights, Construction, Obstruction to flow.

Land adjacent to claimant was bought by the state, and a road was constructed thereupon. Immediately thereafter, claimant's well went dry. Claimant alleged that the percolating waters which fed his well were cut off by the construction operations. Claimant brought action to recover damages for the permanent appropriation of an alleged easement (the path of percolating waters) in his land. The court held the fact that percolating waters on adjoining land would naturally gravitate or seep in the general direction of claimant's lands or his well did not, in absence of proof of the existence of a defined underground stream, establish an easement on the adjoining lands for the benefit of the claimants. Rather, the state, which acquired the property through condemnation proceedings, had a right to use the property for any lawful purpose, and it was fully within its rights in intercepting percolating groundwaters. (Logan-Fla)
W69-06590

SBARRA V ERIE RR (DRAINAGE OF SURFACE WATERS AND PRESCRIPTIVE RIGHTS).
68 NYS 2d 478-481 (Sup Ct 1947).

Descriptors: *Discharge water, *Surface drainage, *Prescriptive rights, *New York, Judicial decisions, Surface waters, Surface runoff, Drainage water, Slopes, Streamflow, Flow augmentation, Groundwater movement.
Identifiers: *Adverse possession, Affirmative defenses, Motions to strike.

The plaintiff sued to enjoin defendant from collecting surface waters and discharging them onto plaintiff's land. The defendant alleged that he had acquired a prescriptive right to discharge such waters onto the plaintiff's land. The defendant claimed that he had discharged surface water onto plaintiff's land for fifteen years without interruption. The discharge which prompted this suit was accomplished in the same manner and was equal in volume to those made continuously for several years. The court held that the right to discharge surface water may be acquired by prescription. The defendant alleged that he acquired this right by continuous adverse use without interruption or complaint. The court held that this allegation was sufficient to allow proof of the acquisition of the right as an affirmative defense. The court denied the plaintiff's motion to have such allegations stricken from the pleadings; the retention of such terms would not unduly prejudice the plaintiff. (Stewart-Fla)
W69-06591

NASSAU COUNTY V CHERRY VALLEY ESTATES, INC (OBSTRUCTION OF ALLEGED WATER COURSE).

114 NYS 2d 666-668 (Sup Ct 1952).

Descriptors: *New York, *Obstruction to flow, *Natural streams, *Surface drainage, Judicial decisions, Legal aspects, Watercourses (Legal), Surface waters, Surface runoff, Drainage water, Drainage, Channels, Discharge (Water), Percolation, Flooding, Streams, Backwater, Relative rights, Ponding.

Plaintiff was discharging water upon defendant's land by means of what plaintiff called 'a stream.' Defendant blocked the 'stream' and caused water to collect on plaintiff's property. Plaintiff sought to enjoin defendant from obstructing this watercourse. The court found that plaintiff was not discharging its surface water into a defined watercourse and, thus, that it had no right to continue to drain surface water over defendant's land. The injunction was denied.
W69-06592

SAMYN V TACEY (ARTIFICIAL DRAINAGE OF SURFACE WATERS).
337 Mich 296, 60 NW 2d 152-154 (1953).

Descriptors: *Surface waters, *Natural flow, *Prescriptive rights, *Michigan, Judicial decisions, Channels, Surface runoff, Drainage water, Slopes, Surface drainage, Streamflow, Dams, Obstruction to flow, Running waters, Overlying proprietor, Ditches.
Identifiers: Injunctions (Mandatory).

Plaintiff, an upper proprietor, brought suit to compel defendant to remove a dam placed by him in a ditch draining surface waters from plaintiff's land. The defendant alleged that he had acquired a

prescriptive right to have his land free from any drainage servitude because the plaintiff had not used the ditch for fifteen years. However, the court found to the contrary. As a result, the court held that since the defendant had not acquired a prescriptive right, he had no right to interfere with the drainage of the surface waters from the plaintiff's land. The granting of the injunction was affirmed. (Stewart-Fla)
W69-06593

OHIO OIL CO V FERGUSON (MINERAL RIGHTS AND ROYALTIES).

213 La 183, 34 So 2d 746-777 (1947).

Descriptors: *Louisiana, *Prescriptive rights, *Drilling, *Oil industry, Royalties, Judicial decisions, Mining engineering, Exploration, Oil, Mineral industry, Leases, Natural resources, Land use, Easements, Mineralogy, Relative rights, Mining.
Identifiers: *Divisibility of servitudes, *Mineral servitude.

Plaintiff brought a concursus proceeding to resolve the conflict among creditors regarding the apportionment of the proceeds from a royalty interest in oil. At the outset, the court noted that there was no difference in the applicable principles of law between a servitude which gives to two or more persons the right to draw water and a servitude which gives two or more people the right to draw oil or gas. The primary issue was whether two of the claimants lost their right to the royalties due to their abandonment of mining operations. The court acknowledged that abandonment or non-use of the right to drill may cause the extinguishment of such right. The court found that, since the claimants had not used the right to drill for ten years, they lost the right to the mineral interest. Such right inures to the benefit of the owner of the land. This is because the obligation is only upon the land; therefore, if the obligation is extinguished, it necessarily inures to the owner of the land at the time of extinguishment. (Stewart-Fla)
W69-06594

CANNON V CITY OF MACON (NATURAL DRAINAGE FLOW AND THE LOWER LAND PROPRIETOR).

81 Ga App 310, 58 SE 2d 563-573 (1950).

Descriptors: *Georgia, *Drainage systems, *Natural flow doctrine, *Surface drainage, Storm runoff, Subsurface runoff, Storm drains, Watercourses, Drains, Local governments, Cities, Pipes, Sewers, Eminent domain, Subsurface flow, Erosion, Damages, Operation and maintenance.

Plaintiffs brought suit against the City of Macon to recover for damage to their house caused by the overflow of a storm sewer. The city was found negligent in maintaining the structures which caused a gradual washing away of the ground around the foundations of the plaintiffs' house. In rendering a judgment for the plaintiffs, the court announced that Georgia had adopted the civil law rule regarding natural drainage. Under this rule, a lower land proprietor owes a duty of servitude to the upper landowner to receive water which naturally runs from the upper tract. However, the upper landowner must not increase the flow by artificial means. (Stewart-Fla)
W69-06595

COX V MARTIN (DISCHARGE OF SURFACE WATER THROUGH A DOWNSPOUT).
207 Ga 442, 62 SE 2d 164-166 (1950).

Descriptors: *Georgia, *Drainage water, *Storm runoff, *Natural flow doctrine, Diversion, Rainfall disposition, Relative rights, Gravity, Surface waters, Drainage effects, Natural flow, Deflection, Pipes, Judicial decisions, Legal aspects.
Identifiers: *Downspouts.

Plaintiff brought action to enjoin the discharge of surface water from defendant's land and to recover damages allegedly caused by such discharge. Under Georgia law, the lower of two adjoining city lots is burdened with a servitude to receive water which naturally flows from the upper tract provided the owner of the higher lot has done nothing to increase such flow by artificial means. The court found that defendant was not liable for damages merely because water from a downspout on his land was discharged directly or indirectly upon the adjoining land of plaintiff unless such flow increased the natural flow at a particular locality upon plaintiff's land or caused water to flow thereon in a manner different from simply running down upon it by the law of gravity. Defendant was granted a new trial. (Reed-Fla)
W69-06596

HARRELL V CITY OF CONWAY (USE OF IMPOUNDED WATER).

271 SW 2d 924-930 (Ark 1954).

Descriptors: *Arkansas, *Riparian rights, *Natural flow doctrine, *Reasonable use, Judicial decisions, Legal aspects, Competing uses, Domestic water, Municipal water, Prescriptive rights, Prior appropriation, Watersheds (Divides), Dams, Relative rights, Streams, Cities, Water users, Water levels, Regulation, Impounded waters, Local governments.
Identifiers: Injunctions (Prohibitory).

Plaintiff city brought action to enjoin upstream riparian owners from taking water from a creek when the water reached a certain level. The court, after recognizing that Arkansas is a 'riparian rights' state, ruled that the city did not have the right to seize and use for its own purposes all the water impounded by its dam when the water level, as measured by a gauge on the dam, fell below six feet. The city's rights are the same as any other riparian owner. Furthermore, since the city is selling the water beyond the boundaries of the watershed, it does not fall under either theory of riparian use (natural flow or reasonable use). The court went on to discount plaintiff's claim of superior rights by prescription as being 'untenable.' The concurring opinion was quick to point out that this case in no way represents a decision by the court to accept either the natural flow or reasonable use doctrines. (Logan-Fla)
W69-06597

FIRES.

Mich Comp Laws Ann secs 70.2, 70.12 (1967).

Descriptors: *Michigan, *Water supply, *Burning, *Cities, Local governments, Damages, Pipelines, Reservoir storage, Water delivery, Legislation, Navigable waters, Boating regulations, Legal aspects, Harbors, Reservoirs, Construction.

The council of any village within the State of Michigan may construct reservoirs in the streets or other suitable places to provide an adequate and convenient supply of water. The council of any village located upon navigable waters may prescribe by ordinance fire prevention regulations which are to be observed by owners, masters, and employees of vessels in the harbor area. (Stewart-Fla)
W69-06598

HARRIS V BROOKS (RECREATION RIGHTS OF RIPARIAN OWNER).
283 SE 2d 129-136 (Ark 1955).

Descriptors: *Arkansas, *Riparian rights, *Reasonable use, *Recreation, Legal aspects, Judicial decisions, Natural flow doctrine, Competing uses, Prior appropriation, Fishing, Lakes, Nonnavigable waters, Domestic water, Water levels, Irrigation, Riparian waters, Riparian land, Pumping, Swimming, Relative rights.
Identifiers: Injunctions (Prohibitory).

Plaintiff and defendant were riparian owners on a nonnavigable lake. Plaintiff, owner of a fish camp, sought to enjoin defendant from pumping water out of the lake, claiming that continued pumping would make the lake unsuitable for fishing and recreation. The reasonable use doctrine as applied to riparian owners allows the riparian owner to make any reasonable use of his property, so long as such use does not injure other riparian owners. Here, the pumping of water by the defendant lowered the level of the lake to such an extent that the aquatic life in the lake was endangered. The right to use water for domestic purposes is superior to the right to use water for recreational purposes, but all other lawful uses are equal in the eyes of the law. Since defendant's continued pumping for irrigation would interfere with plaintiff's equal right to use the lake, plaintiff was entitled to injunctive relief. (Shevin-Fla)
W69-06599

DRAPER V MOSHIER (INTERFERENCE WITH DRAINAGE DITCH).

92 A 2d 715-717 (Ch Del 1952).

Descriptors: *Delaware, *Prescriptive rights, *Surface drainage, Overflow, Easements, Right of way, Ditches, Real property, Legal aspects, Drainage systems, Judicial decisions, Relative rights, Benefits.
Identifiers: Parol license, Injunctions (Mandatory), Estoppel.

Plaintiff brought suit against an adjoining landowner for a mandatory injunction to abate or discontinue interference with a drainage ditch constructed by plaintiff's predecessor in title across defendant's land. Plaintiff contended that the ditch was dug for the mutual benefit of the adjoining lands and that this was an action for specific enforcement of a mutually beneficial agreement. The court concluded from the evidence that the ditch was dug solely for the benefit of the property owned by plaintiff. Furthermore, the testimony was undisputed that plaintiff's predecessor in title was granted merely a parol license to maintain a ditch. Such a license could be revoked by defendant at any time as no prescriptive rights had attached. There being no evidence of fraud or other inequitable conduct justifying the requested relief, the court concluded that defendant was entitled to fill the ditch. The complaint was dismissed. (Reed-Fla)
W69-06600

WHITE OAR BOROUGH AUTH V PENN PUB U COMM'N (AQUISITION OF PUBLIC WATER FACILITIES).

175 Pa Super 114, 103 A 2d 502-507 (Pa Super Ct 1954).

Descriptors: *Administrative agencies, *Jurisdiction, *Waterworks, *Pennsylvania, Judicial decisions, Water conveyance, Eminent domain, Public utilities, Water rates, Cities, Contracts, Condemnation.

Plaintiff applied to defendant Public Utility Commission for a certificate of public convenience and necessity evidencing the defendant's approval of the plaintiff's proposed acquisition of water facilities owned by the municipality. The facilities, which were owned and operated by the municipality, were located outside the city limits and entirely within the Borough. Since the plaintiff had not shown any procedure or authority by which it could coerce acquisition, the Commission ruled that it was without jurisdiction. In a prior judicial proceeding, the state superme court ruled that the plaintiff had no right to use eminent domain to compel acquisition. In attempting to establish that defendant did have jurisdiction, the plaintiff relied upon the Municipal Authorities Act. However, that Act contemplates acquisition by agreement from a consenting owner. The Legislature provided for acquisition of water works only by agreement, not by compulsory process. Therefore, the refusal of

the defendant to entertain jurisdiction was affirmed. (StewartsFla)
W69-06601

CITY OF PORTSMOUTH V CULPEPPER (SUIT FOR DAMAGES RESULTING FROM OVERFLOW OF OBSTRUCTED CANAL).
192 Va 362, 64 SE 2d 799-804 (1951).

Descriptors: *Virginia, *Earth dams, *Obstruction to flow, *Overflow, Dams, Banks, Spillways, Canals, Natural flow, Rain water, Excess water (Soils), Rainfall, Excessive precipitation, Flood damage, Crops, Flooding, Shrubs, Trees, Weeds, Cities, Judicial decisions, Legal aspects, Damages, Local governments.
Identifiers: Act of God, Debris.

Plaintiff brought action against defendant city to recover for damage to crops sustained when a canal maintained by the city overflowed. Evidence showed that the city had begun to build a dam across its canal. The dam was never completed, but was allowed to remain in the canal. Trees, bushes and weeds were allowed to grow over the dam to such an extent that the court found the canal was necessarily obstructed. The court held that this obstruction caused the overflow of the canal during heavy rains which resulted in the damage to plaintiff's crops. The court rejected defendant's contention that this was an act of God. The court felt the jury was justified in finding that this dam was a nuisance which the city had permitted to stand unabated. (Logan-Fla)
W69-06602

ZOMBKOWSKI V WISCONSIN RIVER POWER CO (FLOODING DAMAGES CAUSED BY DAM CONSTRUCTION).

267 Wis 77, 64 NW 2d 236-240 (1954).

Descriptors: *Wisconsin, *Dams, *Obstruction to flow, *Flooding, Power plants, Reservoirs, Dam construction, Sewers, Reservoir leakage, Remedies, Judicial decisions, Eminent domain, Condemnation, Water levels, Legal aspects, Flood damage, Backwater, Legislation.
Identifiers: Wisconsin River.

Plaintiff brought action to recover for damage allegedly caused by defendant's dam. The dam caused the waters of the Wisconsin River to rise to such a level that plaintiff's land was partially flooded. The waters did extensive damage to plaintiff's buildings and merchandise. Defendant admitted liability, and only the amount of the damages was at issue. Based upon answers in a special verdict, damages were set at a figure in excess of $14,000. Defendant appealed, alleging that plaintiff's only remedy was by condemnation. The supreme court of Wisconsin held that, under section 330.17 of the Wisconsin Statutes, plaintiff could sue for damages where the power company did not take the land by condemnation before the damage occurred. Defendant could not allege on appeal that damages were caused by percolating groundwater since it had admitted liability at trial. Finally, evidence supported the jury's finding that a sewage system installed after construction of the dam would not be as effective as one installed prior to such construction. (Kahle-Fla)
W69-06603

IOWA-WISCONSIN BRIDGE CO V UNITED STATES (LIABILITY FOR RESERVOIR OPERATION).

84 F Supp 852-870 (Ct Cl 1949).

Descriptors: *Mississippi River, *Impounded waters, *Dams, *Compensation, Hydraulic structures, Reservoirs, Reservoir stages, Ice jams, Ice breakup, Eminent domain, Bridges, Condemnation, Prescriptive rights, Easements, United States, Federal government, Dikes, Permeability, Underseepage, Retaining walls, Earthworks, Access routes, Roadbanks, Streams, Judicial decisions, Legal aspects, Competing uses, Reservoir operation, Navigable waters, Ownership of beds, River beds, Remedies, Damages, Right-of-way.

Plaintiff sued to recover for alleged taking of its property by the government's construction of a downstream lock and dam. Plaintiff owned the right-of-way to construct and maintain a bridge across the Mississippi River as well as the right-of-way to maintain approaches to the bridge across nonnavigable sloughs adjacent to the river. The damage complained of was done to the approach dikes and bridges across these sloughs. Defendant operated its dam in such a manner as to keep the water level at 620 feet, a level equal to the height of plaintiff's dikes and 4 feet above normal level. This resulted in supersaturation of the dikes and consequent road surface crumbling. The wooden bridges over the sloughs were weakened by the increased ice flowage attributable to the dam. The court, in awarding plaintiff damages, noted that since the sloughs were nonnavigable and not subject to a public servitude in the interests of commerce, the government was liable. (Katz-Fla)
W69-06604

STATE V TAYLOR (FISH DYNAMITED IN PRIVATE POND).
214 SW 2d 34-38 (Mo 1948).

Descriptors: *Missouri, *Explosives, *Legislation, *Fish conservation, Ponds, Public rights, Nonnavigable waters, Jurisdiction, Fish management, Public benefits, Fishkill, State governments, Legal aspects, Regulation, Fish, Relative rights, Wildlife, Judicial decisions.
Identifiers: *Criminal law, Private ponds.

Defendant appealed from a conviction of the criminal offense of dynamiting fish in a private pond. Defendant assigned as error the fact that a private pond is not included within the term 'waters of this state,' as mentioned in the statute under which he was convicted. The court held that while title to fish reduced to one's possession by lawful means is released by the state to the taker, fish in a private pond have not been so reduced to possession as to vest unqualified to the fish in the owner of the pond and thereby destroy all regulatory power of the state. The title to fish asserted by the statute to be in the state for the purposes of preservation, propagation, and protection is not inconsistent with the qualified special property right of the owner of the soil where they are found, as against trespassers. Thus, the court concluded that defendant, as a trespasser who dynamited and killed fish in a private pond, was properly convicted under the statute prohibiting the placing of explosive substances in 'waters of the state' whereby fish may be destroyed. (Reed-Fla)
W69-06605

LAWKINS V CITY OF NEW YORK (EROSION AND ACCRETION OF BOUNDARY SHORE LINE).

272 App Div 920, 71 NYS 2d 112-115 (1947).

Descriptors: *New York, *Boundaries (Surfaces), *Beach erosion, *Accretion (Legal aspects), Cities, Atlantic Ocean, Shores, Islands, Legislation, Tidal waters, Avulsion, Boundary disputes, Coasts, Deposition (Sediments), Taxes, Beaches, Land tenure.
Identifiers: Suit for refund.

Plaintiff brought this action against city to recover taxes paid under protest. From a summary judgment for plaintiff, defendant appealed. The city's right to tax property depends upon whether the property taxed was located within the city's territorial limits as fixed by charter. After a consideration of pertinent cases, the court stated that it was the intention of the legislature that the city's boundary line should extend to the ocean shore line of the then existing beach. The court noted further that if in time the beach disappeared and later another piece of land reappeared in the same location (this latter formation being in no way identified with the former beach), the city boundary line was not to extend to the ocean shore line of the new land if that land was further south than the original shore line. Later, the beach lands were washed away by the process of erosion. The court ruled that the accretions to plaintiffs' tract formed after erosion of the beach lands within the city's boundaries did not serve to advance the city boundaries to include such accretions. Therefore, the court held that summary judgment had been properly granted to plaintiff. (Reed-Fla)
W69-06606

GIBSON V STATE (CONSTRUCTION AND MAINTENANCE OF SEWERS).

64 NYS 2d 632-644 (Ct Cl 1946).

Descriptors: *New York, *Storm runoff, *Sewers, *Highway effects, Overflow, Floods, Drainage, Drainage engineering, Storms, Rainwater, Surface runoff, Surface waters, Damages, Remedies, Judicial decisions, Legal aspects, Operation and maintenance, Rainfall-runoff relationships, Cities, Local governments, State governments, Highways.

Following a severe rain storm, water flowed from a nearby highway intersection onto plaintiff's property, damaging said property rather extensively. Plaintiff brought suit, alleging that the damage resulted from defendant's negligence in building and maintaining a highway sewerage system. The court granted defendant's motion for dismissal. It found that the state was under no duty to provide drainage for plaintiff's property. However, when a municipal corporation puts a sewerage plan into operation, it becomes liable for damages resulting from negligence in the construction and/or the maintenance thereof. In the case at bar, the evidence failed to establish any such negligence. The court also held that a municipality is not liable for an increase in flow of surface waters resulting solely from the paving of streets and the placement of other improvements. Liability may exist if the state diverts the surface runoff of a water shed from the course of its natural flow or collects such runoff in an artificial channel and discharges it in great volume upon the lands of another. But, in this case, the evidence disclosed no accumulation of water beyond that which would normally result from the construction of streets and roadbeds. (Gabrielson-Fla)
W69-06607

UNITED STATES V GROEN (TITLE TO FILLED IN LAND BORDERING ON A RIVER).
72 F Supp 713-723 (DDC 1947).

Descriptors: *District of Columbia, *Bulkhead line, *Riparian rights, *Ownership of beds, United States, Rivers, Federal government, Landfills, Piers, High water mark, Relative rights, Riparian land, Shores, Judicial decisions, Legal aspects, Navigable waters, Land tenure, Legislation, Public benefits.
Identifiers: Anacostia River.

The United States brought suit in equity, to determine title to waterfront land and adjacent beds in the District of Columbia, to define the nature and extent of any interest adverse to the United States, and to ascertain the value of any such interest. It was conceded that defendants owned the land bordering on the Anacostia River to the high water mark as that mark existed in 1794. The principal issue to be resolved was whether defendants' predecessors in title had the right to fill the land and to erect a wharf beyond that high water mark extending to a bulkhead line established in 1899. The court held that defendants had acquired ownership of the filled-in land since such filling was a proper exercise of riparian rights. Defendants could not be deprived of this property except for

public purposes and then only upon the payment of just compensation. The court held that title to the property in question had been in plaintiff when the federal government acquired the city, but that the establishment of the bulkhead line operated as a license to fill or wharf out to that line. The court stated that local law was controlling as to the nature and extent of riparian rights. (Wheeler-Fla)
W69-06608

BINGENHEIMER V DIAMOND IRON MINING CO (DEFINITION OF NAVIGABLE WATER TO DETERMINE OWNERSHIP OF BEDS).

54 NW 2d 912-926 (Minn 1952).

Descriptors: *Navigable waters, *Minnesota, *Ownership of beds, *Land tenure, Dams, Sluices, State governments, Lakes, Saw log test, Judicial decisions, Legal aspects, Land classification, Real property, Beds, Water utilization, Nonnavigable waters.

Plaintiffs brought action to register title to certain lands, joining the state as defendant. Defendants claimed title to the bed of a chain of lakes on plaintiffs' property and asserted that the entire tract should therefore not be registered. The district court denied the application for registration, On appeal, the supreme court considered the issue whether the waters were navigable at the time the state was admitted to the union; if they were navigable, title to the beds would have vested in the state and not in plaintiffs' predecessor in title. The court held that waters navigable in fact were considered navigable in law. Navigable waters were defined as waters used, or susceptible of use, in their ordinary or natural condition, as highways of commerce. The court held artificial aids were acceptable if reasonable, to make a water way navigable. The court held on the facts of this case, however, that a waterway capable only of floating logs for three days a year with artificial aids from sluices and dams, was not navigable. Therefore title passed by mesne conveyances to plaintiffs and should be registered. (Harris-Fla)
W69-06609

BELL TEL CO V DRAVO CORP (UNDERWATER OBSTRUCTION TO NAVIGATION).
371 Pa 98, 88 A 2d 737-741 (1952).

Descriptors: *Navigation, *Pennsylvania, *Ships, *Damages, Admiralty, Ohio River, Rivers, Navigable waters, Shallow water, Boats, Remedies, Judicial decisions, Permits, Federal government, Legal aspects, Channels, Stream beds.
Identifiers: *Cables, *Obstruction to navigation.

Plaintiff was granted a permit in 1922 to lay a submarine cable in a trench three feet beneath the bed of a navigable river. In 1948, plaintiff sued for damages after defendant's towboat, maneuvering in shallow water, apparently struck and damaged this cable. The jury returned a verdict for the plaintiff and defendant appealed. The supreme court held that the trial judge should have granted a judgment notwithstanding the verdict for defendant. Ships have the paramount right to use navigable waters free from obstruction. Thus, the plaintiff had the burden of showing that the cable was maintained in its original position, or at least in a position where it would not obstruct navigation. However, the only reasonable inference from the evidence was that the cable had not been properly maintained and had become uncovered so as to create an obstruction to navigation. Defendant was not negligent in operating his towboat in shallow water. In a navigable stream, a ship has the right to operate wherever it can do so under its own power. (Gabrielson-Fla)
W69-06610

LEONARD V STATE HIGHWAY DEPT (ACQUISITION OF TITLE BY STATE THROUGH PERMANENT FLOODING OF LAND).

29 N J Super 188, 103 A 2d 97-101 (1954).

Descriptors: *New Jersey, *Ownership of beds, *Boundaries (Property), *Tidal effects, Condemnation, Land reclamation, Legal aspects, Tidal waters, Riparian rights, Land tenure, Dikes, State governments, Road construction, Judicial decisions, Avulsion, Appropriation, Ownership of beds, Water level fluctuations, Eminent domain.
Identifiers: *Riparian grants.

Plaintiffs brought suit to set aside a riparian grant to the State of New Jersey, to confirm that plaintiffs were the owners of the tract in question, and to require defendants to institute proceedings to condemn the land already taken for highway purposes. Plaintiffs' predecessor in title constructed a dike along a creek, excluding tidewaters from plaintiffs' land. Breaches in the dike had permitted flooding of the land to the extent experienced before the dike was constructed. After obtaining its riparian grant, defendant highway department removed the dike embankments which allegedly were the plaintiff's property. The Chancery Division dismissed the complaint. On appeal, the superior court held that a riparian owner might appropriate land which was previously a tide-flowed shore. However, the natural flooding of the land subsequent to the exclusion by the dike revested title in the state. The principle of avulsion applies with the result that a temporary flooding would not divest title already vested. The state need not give notice of its application for a riparian grant. (Harris-Fla)
W69-06611

WATERS AND WATER SUPPLY.

58 N J Stat Ann secs 19-15 to 19-20 (1966).

Descriptors: *New Jersey, *Legislation, *Administrative agencies, *Condemnation, Eminent domain, Water districts, Remedies, Water distribution (Applied), Public utilities, Public utility districts, Compensation, Condemnation value, Legal aspects, Water conservation, Water sources, Adjudication procedure, Real property, Water supply, Supervisory control (Power), Regulation.

The commissioner of a regional water division may perform all acts which the division may perform. To facilitate performance of division duties, Department of Conservation personnel may be assigned by the commissioner to division tasks. Public and private property may be condemned by the Division, however, public or private water systems may be condemned only for purposes of construction, development, or acquisition of a water supply system. Any person entitled to a compensation award who holds over on condemned property will be charged the reasonable value of use and occupancy of the property for the period subsequent to condemnation. To commence condemnation proceedings, the Division files a bill of taking describing the property, declaring the estate condemned and estimating reasonable compensation. Title vests in the state subsequent to such filing and on deposit of the compensation estimate with the court. The Board shall have the power to make reasonable regulations concerning public utility facilities. The Board may order a public utility to relocate providing that expenses incurred thereby are paid by the Division. (Katz-Fla)
W69-06612

CALIFORNIA CO V PRICE (OWNERSHIP OF NAVIGABLE WATER BED).
225 La 706, 74 So 2d 1-29 (1953).

Descriptors: *Louisiana, *Ownership of beds, *Boundaries (Property), *Bays, Beds, Gulf of Mexico, Legislation, Prescriptive rights, Tidal waters, Oil, Oil wells, Patents, Royalties, Leases, Proprietary power, Riparian land, Riparian rights, State governments, Administrative agencies, Legal aspects, Judicial decisions, Navigable waters.
Identifiers: Concursus proceedings.

Plaintiff instituted a concursus proceeding to determine ownership of accumulated oil royalties from wells drilled in the bed of a navigable bay. Louisiana claimed the funds by virtue of inherent sovereignty over navigable waters and beds. The Beckwith group asserted a rival claim founded on an 1874 patent from the state. The state contended that the rival claim was invalid in that it was against public policy to permit private ownership of the beds of navigable waters. The state also asserted title to the property by tax deed. The court recognized that Beckwith's patent was irregularly granted but determined that the legislature had ratified the grant by passage of an 1912 Act requiring all suits to vacate or annul a state patent to be brought within 6 years of the grant or passage of the act. The court noted that the tax deed had been officially cancelled. On rehearing, title was affirmed in the Beckwith group over a vigorous dissent protesting the ability of a private person to own the bed of navigable waters. (Katz-Fla)
W69-06613

BALL CREEK COAL CO V NAPIER (MEANDERS AS A BOUNDARY).

305 Ky 308, 202 SW 2d 728-731 (1947).

Descriptors: *Kentucky, *Accretion (Legal aspects), *Streams, *Boundaries (Property), Judicial decisions, Legal aspects, Meanders, Abatement, Riparian land, Boundary disputes, Riparian rights, Bank erosion, Relative rights, Land, Real property, Land tenure.
Identifiers: Calls.

The plaintiff owned a tract of land across from and south of a creek which flowed from defendant's tract. Plaintiff's deed affixed the northern property boundary as the meanders of the creek. Plaintiff brought this action in trespass to enjoin defendant from using an irregular strip on the north boundary of the dividing creek. Plaintiff contended defendant's grantor had not affixed defendant's southern boundary as the meanders of the creek. The court examined defendant's deed and ascertained that, although the word 'meanders' was not used in the deed, the call set forth conformed substantially to the meanders of the creek. Title was therefore found to be vested in the defendant. (Katz-Fla)
W69-06614

BURNQUIST V FISCHER (FLOWAGE EASEMENT APPURTENANT TO DAM).

71 NW 2d 161-167 (Minn 1955).

Descriptors: *Minnesota, *Dams, *Prescriptive rights, *Overflow, Easements, Lakes, Navigable waters, Public rights, Legal aspects, Water levels, Water level fluctuations, Judicial decisions, Structures, State governments, Flood damage, Flow, Maintenance.
Identifiers: *Perpetual flowage easements, Common law dedication, Presumptions.

The state brought action against certain persons who owned lands over which the state sought to establish a flowage easement appurtenant to an existing dam. The trial court found that defendants had dedicated a perpetual flowage easement over the lands in question for all overflow resulting from the existence of the dam at a crest elevation of 1065.40. To establish a common law dedication, the owner's intent to surrender or appropriate property to public use and acceptance thereof by the public must be shown. The statutes governing perpetual flowage easements do not supersede the common law regarding dedication of flowage easements; however, they do provide a minimum factual standard under which common law implied dedication will be presumed. The mere failure of defendants to bring action to abate the dam immediately after flooding of a portion of their lands did not imply acquiescence in all possible overflow resulting from maintenance of the dam. The court,

finding that the evidence did not sustain a finding of common law dedication for overflow on defendants' lands resulting from existence of the crest elevation of the dam, reversed the trial court's order and entered judgment for defendants. (Reed-Fla)
W69-06615

GREAT LAKES COMPACT (AGREEMENT FOR EFFICIENT MANAGEMENT OF THE GREAT LAKES BASIN).

Mich Comp Laws Ann, secs 3.601-3.607, 3.651-3.655 (1967).

Descriptors: *Michigan, *Interstate compacts, *International commissions, *Great Lakes, Interstate commissions, Legislation, Great Lakes Region, Lakes, International joint commission, International law, Federal government, State governments, Water law, Water policy, International waters, Fishing, Hydroelectric power, Water resources, Bank erosion, Navigation, Water pollution, Treaties.
Identifiers: *Great Lakes Commission, *Great Lakes Compact, Great Lakes Basin.

The governor of Michigan is empowered to execute an agreement with states and provinces bordering on the Great Lakes for the purpose of insuring proper management, control, and supervision of the waters of the Great Lakes. Michigan, by this statute, ratified the Great Lakes Basin Compact, the purposes of which are: (1) to promote the development, use, and conservation of the Great Lakes Basin; (2) to plan for water resources development and welfare; (3) to promote benefit from public works; (4) to secure a proper balance in the use of the Basin; and (5) to establish an agency to accomplish these purposes. The statute creates an intergovernmental agency, The Great Lakes Commission, and delineates its powers and functions. The Commission may consider and recommend policy, regulations, and agreements effecting parties to the Compact. The parties agree to consider the recommendations of the Commission regarding such areas as pollution, navigation, lake levels, fishing, hydroelectric power, soil and bank erosion and water diversion. The state pledges its cooperation in carrying out the Compact. (Helwig-Fla)
W69-06616

FRODERMAN V DIETZ (PRIVATE DAMS FOR FLOOD CONTROL).

92 NE 2d 553-555 (Ind 1950).

Descriptors: *Indiana, *Easements, *Dam construction, *Flood control, Judicial decisions, Flow control, Gates, Outlet works, Ponding, Water supply, Water conservation, Water control, Ponds, Drainage control, Flood protection, Water levels, Contracts.
Identifiers: *Oral agreements, Injunction (Prohibitory).

Plaintiff sued to enjoin the opening of outlets on a dam. The dam was necessary to maintain a constant water level in a pond subject to seasonal fluctuations. Originally, the plaintiff and two other landowners agreed to construct the dam. They were to have joint and several control over the outlets so that flooding would be prevented. The defendant, on whose land the pond was located, had purchased his tract from the prior owner with full knowledge of the existing agreement. Later, however, he refused to comply with the terms of the contract. He assumed complete control over the operation of the outlets. The court entered a judgment for the plaintiff, whose business depended upon a steady flow of water. The court granted the plaintiff the right to enter upon the defendant's land for the purpose of maintaining, operating, and controlling the dam. The decision was affirmed on appeal. (Stewart-Fla)
W69-06617

BAILEY V DRISCOLL (IMPLIED LIMITATION ON GRANT OF SUBMERGED LAND).

19 NJ 363, 117 A 2d 265-271 (1955).

Descriptors: *New Jersey, *Beds, *Ownership of beds, *Tidal waters, Administrative agencies, State governments, Legislation, Legal aspects, Riparian rights, Riparian lands, Islands, Boundaries (Property), Prescriptive rights, Navigable waters, Judicial decisions, Public lands, Public benefits, High water mark, Low water mark, Beds under water, Remedies, Rivers, River beds.

Plaintiff owner of an island located beyond the mainland property of defendant brought this action to have a grant of submerged lands declared invalid. The grant was made to defendant by the Council of Planning and Development Division of the State Conservation Department and conveyed to him the submerged lands in front of his riparian property to the center of the estuary. The court held that the legislation authorizing grants of underwater lands in front of property of a riparian tidewater owner implied a limitation on outward extension of such grants. The court determined that the established bulkhead or pier line was the proper limitation on the extent of such grants. The court, in correcting the termination point of defendant's grant, found that the plaintiff's property interest in submerged lands extending outward from his island was not infringed upon by defendant's grant. (Katz-Fla)
W69-06618

STATE V CITY OF CLEVELAND (RIGHT OF ACCESS TO NAVIGABLE WATERS).
150 Ohio St 303, 82 NE 2d 709-730 (1948).

Descriptors: *Landfills, *Ownership of beds, *Appropriation, *Ohio, Littoral, Riparian rights, Shallow water, Lake Erie, Condemnation, Compensation, Right of way, State governments, Local governments, Docks, Navigable waters, Navigation, Water law, Shores, Cities, Great Lakes, Damages, Remedies, Judicial decisions, Eminent domain, Legal aspects, Nonnavigable waters, Highways.
Identifiers: Fact questions.

Plaintiff owned land on Lake Erie and had commenced to fill in the shallow nonnavigable waters of the lake for the dual purpose of adding upland and wharfing out to navigable waters. Defendant entered this fill and constructed a highway across it, cutting off plaintiff's access to the sea. Plaintiff sued for compensation, and the trial court ordered the jury to assess damages. Defendant appealed; the court of appeals reversed, basing its decision on a statute which provided that a municipal corporation could build any work in aid of navigation and water commerce upon fill on submerged land without compensation. Plaintiff appealed this decision. The supreme court found that the state holds title to subaqueous land in trust for the protection of the public rights of navigation and commerce. The littoral owner has the right to wharf out to navigable waters provided he does not interfer with those public rights. The case turned on whether the highway was built in aid of navigation and water commerce. Determination of such a question is province of the jury, and thus, the court reversed and remanded for a new trial. (Gabrielson-Fla)
W69-06619

NANTAHALA POWER AND LIGHT CO V SLOAN (FLOWAGE EASEMENTS).

227 NC 151, 41 SE 2d 361-364 (1947).

Descriptors: *North Carolina, *Easements, *Condemnation, *Dams, Condemnation value, Flooding, Reservoirs, Power plants, Local governments, Judicial decisions, Damages, Power operation and maintenance, Eminent domain, Public utilities, Legal aspects.

The petitioner power company instituted this condemnation proceeding to acquire a flowage easement on respondent's land for an increase in the level of a reservoir created by a 25 foot dam. A consent judgment had been entered in 1928 granting an easement on respondent's land for the original reservoir level, and, over respondent's objection, this judgment was entered into evidence at trial. This court ordered a new trial, holding that the original judgment was inadmissable since respondent had admitted the existence of the prior easement. The judgment was not admissable on the issue of damages to be awarded respondent for the easement since it was too remote and there was evidence of a compromise. Respondent was entitled to recover the difference in the fair market value of her property immediately before the additional burden was placed upon it and the fair market value of the property immediately thereafter. (Kahle-Fla)
W69-06620

XIDIS V CITY OF GULFPORT (USE OF SUBMERGED LANDS FOR PUBLIC PURPOSE).
72 So 2d 153-160 (Miss 1954).

Descriptors: *Mississippi, *Harbors, *Eminent domain, *Beds under water, Public lands, Riparian rights, Condemnation, Public benefits, Public rights, Legal aspects, Navigable waters, Ownership of beds, Cities, Compensation, Remedies, State governments, Judicial decisions, Legislation, Financing.
Identifiers: *Bond issue, Injunctions (Mandatory), Injunctions (Prohibitory).

The plaintiffs brought this action for an injunction to restrain the defendant from constructing a small craft harbor in front of plaintiff's property. Plaintiffs' land was separated from the shoreline by a four-lane highway. The plaintiffs alleged that construction of the harbor would deprive them of their riparian rights. They also claimed that their property was being taken without just compensation. Finally, they charged that the defendant did not have authority to use the funds derived from a bond issue because the electors did not receive sufficient notice of the purposes for which the bonds were issued. The court ruled against the plaintiff on all three counts and dismissed the complaint. Land below navigable waters belongs to the state and is held in trust for public benefit. The city's use of land underlying navigable waters for a public purpose does not constitute a 'taking' of private property for which compensation must be paid. Furthermore, the court found that the deeds, statutes, and bonds upon which the defendant relied for authorization were valid. Therefore, the defendant was allowed to construct the small craft commercial harbor according to plan. (Stewart-Fla)
W69-06621

FONADELLAS V UNITED STATES (TEMPORARY TAKING OF PROPERTY FOR PUBLIC PURPOSE).

107 F Supp 1019-1023 (Ct Cl 1952).

Descriptors: *Puerto Rico, *Compensation, *Channel improvement, *Flood damage, Federal government, Canal construction, Easements, Condemnation, Channel erosion, Dredging, Depth, Channel flow, River basin development, Water spreading, Beds, Saline water, Mud, Silts, Eminent domain, Damages, Condemnation value, Judicial decisions.
Identifiers: *Tucker Act.

Plaintiff brought this action under the Tucker Act to recover compensation for the taking of his property by the government. Defendant constructed an additional channel in the harbor area of San Juan, Puerto Rico, and, while doing so, caused some of the plaintiff's land to become buried under mud and silt. Also, because of the construction, portions of the plaintiff's lands were flooded with

salt water. Defendant had plaintiff's permission for the construction of the canal; however, the court said that this did not constitute, as defendant contended, a waiver of claim for any damages. The court ruled that such action on behalf of the defendant constituted a taking, not by appropriation but by destruction. The fact that the taking was temporary did not relieve the defendant from the duty to reimburse plaintiff for his damages. (Stewart-Fla)
W69-06622

KANSAS CITY LIFE INS CO V UNITED STATES (IMPAIRMENT OF LAND VALUE DUE TO DAM CONSTRUCTION).

74 F Supp 653-656 (Ct Cl 1947).

Descriptors: *United States, *Groundwater barriers, *Condemnation, *Drainage, Groundwater movement, Groundwater, High water mark, Judicial decisions, Legal aspects, Eminent domain, Missouri, Mississippi River, Surface runoff, Creeks, Non-navigable waters, Water levels, Dams, Backwater, Locks, Drainage systems, Surface waters, Federal government.
Identifiers: Due process.

The construction by the government of a lock and dam in the Mississippi River raised the water level in the river and in a non-navigable creek bordering plaintiff's land. The raised creek level prevented drainage of underground and surface water from plaintiff's land. Plaintiff sued the United States to recover compensation for impairment of the land's farming value. The court awarded judgment for plaintiff. It was held that the impairment constituted a taking of land within the meaning of the 5th amendment of the Federal Constitution. The government was not privileged to deprive plaintiff of the right to drain his land even though such deprivation was incidental to the improvement of navigation in the Mississippi River. The dissent noted that numerous Supreme Court cases had denied recovery for property damage where the water level was not raised above the high water mark. (Wheeler-Fla)
W69-06623

CHRISTMAN V STATE (NEGLIGENCE IN CULVERT CONSTRUCTION).

70 NYS 12-16 (Ct Cl 1947).

Descriptors: *New York, *Road construction, *Drainage systems, *Culverts, Storm runoff, Surface runoff, State governments, Ditches, Drainage, Highways, Topsoil, Humus, Erosion, Watersheds (Basins), Flood control, Streams, Topography, Accelerated erosion, Storm drains, Legal aspects, Judicial decisions, Excessive precipitation, Rainfall intensity, Obstruction to flow, Damages.
Identifiers: Proximate cause.

Claimant sued the State of New York for property damages arising from State's alleged failure to exercise due care and diligence in providing an adequate drainage system and culverts in connection with the construction of a highway. The court found that the State had a duty to provide culverts which would adequately carry off reasonable quantities of water from the watershed area. It further held that the State had breached this duty and would be liable for all damages to plaintiff. The court also based liability upon the State's failure to keep culverts free from obstructions. Defendant's argument that a rainfall of two inches in three hours, similar to past rainfalls in that area, was an 'act of God' was rejected since such a quantity of rainfall could have been reasonably anticipated. (Logan-Fla)
W69-06624

HARDY V KANSAS CITY (FLOODING CAUSED BY OBSTRUCTION TO WATER FLOW).

284 SW 2d 27-31 (Mo Kansas City Ct App 1955).

Descriptors: *Missouri, *Obstruction to flow, *Negligent inundation, *Cities, Flooding, Flood damage, Drainage, Storm drains, Surface runoff, Sewers, Embankments, Rainfall intensity, Drainage water, Project planning, Engineers estimates, Contract administration, Remedies.
Identifiers: Independent contractors, Proximate cause.

Plaintiff brought suit against defendant city to recover damages for flooding of her land. The flooding was allegedly caused by obstruction of the natural flow of a creek and by the removal or destruction of existing drainage facilities by constructing of a sanitary and storm sewer. Defendant alleged that the acts complained of were the voluntary acts of a construction company, an independent contractor. The court pointed out that the evidence failed to sustain this contention. Defendant also contended that plaintiff failed to establish every essential element of his cause of action since the evidence disclosed that the flooding would have occurred regardless of the acts complained of. The court concluded that there was evidence sufficient to go to the jury on the issue whether the flooding was due to the filling of the creek, the destruction of existing drainage facilities, and the failure of defendant to provide other facilities. As the question of defendant's liability was properly decided in plaintiff's favor by the jury, defendant was liable for damages resulting from the flooding of plaintiff's land. (Reed-Fla)
W69-06625

POTEETE V CITY OF WATER VALLEY (ARTIFICIAL CONTROL OF SUBSURFACE DRAINAGE).

57 So 2d 565-567 (Miss 1952).

Descriptors: *Mississippi, *Local governments, *Subsurface drainage, *Drainage water, Culverts, Drains, Outlet works, Judicial decisions, Damages, Levees, Barriers, Slopes, Grading, Embankments, Roadbanks, Elevation, Cities, Legal aspects.

The plaintiff brought this suit to recover for damages allegedly resulting from the raising of the street level by the defendant. The plaintiff contended that this caused large quantities of water to be cast upon his property. In addition, the plaintiff alleged that the defendant had substituted a smaller drainage culvert for the one previously used. The court held that in order for plaintiff to recover damages the burden was upon him to show that defendant had raised, or changed, the grade of the street, so as to cast the water on plaintiff's property. The jury verdict must be sustained if plaintiffs do not meet this burden. (Stewart-Fla)
W69-06626

CLEMENTS V TOWN OF CARROLLTON (DAM ACROSS DRAINAGE DITCH).
63 So 2d 398-400 (Miss 1953).

Descriptors: *Mississippi, *Obstruction to flow, *Dams, *Surface runoff, Ditches, Natural flow, Cities, Check structures, Overflow, Culverts, Diversion, Surface waters, Judicial decisions, Diversion structures, Drainage effects, Road construction.
Identifiers: *Injunctions (Mandatory).

Plaintiff town brought this suit for damages and for an injunction to have a dam across a drainage ditch on defendants' property removed. Defendants filed a cross-bill for damages to their property on the ground that the town had increased the natural flow of water into the drainage ditch by blacktopping a street, and had negligently failed to deepen and clean the ditch. A preliminary injunction was issued and served upon defendants and, within two weeks, they removed the dam. The trial court entered a perpetual injunction requiring the removal of the ditch but denied damages to the town. The cross-bill was dismissed. Defendants appealed, contending that the chancellor's findings were not supported by the evidence. As to defendants' contention that the town was negligent in its failure to deepen and clean the ditches, the court indicated that the decision of the chancellor, who viewed the premises, would not be disturbed unless not supported by substantial evidence. The court held that the chancellor's decree was amply supported by the evidence and should not be disturbed. Accordingly, the decree of the trial court was affirmed. (Reed-Fla)
W69-06627

UNITED STATES V TURNER (OWNERSHIP OF BEDS UNDER SHALLOW WATERS).

175 F 2d 644-651 (5th Cir 1949).

Descriptors: *Alabama, *Ownership of beds, *Landfills, *Shallow water, Dredging, Riparian rights, Navigation, Beds, State governments, Bays, Accretion (Legal aspects), Erosion, Condemnation, Compensation, Damages, Remedies, Judicial decisions, Right of way, Navigable waters, United States, Legal aspects, High water mark.
Identifiers: *Right of access.

Appellant sought to condemn land held by appellee. Appellant alleged that most of the land had been submerged prior to being filled in by appellee, and therefore, that the title to such land was still in the state. The trial judge ruled: (1) that the state had lost title to the formerly submerged land because the waters covering it had been too shallow for navigation; (2) that even if the state had owned the submerged portions, appellee acquired title by exercizing his right to fill in the shallows out to deep water. The jury awarded a substantial sum to the appellee, and appellant appealed. The court of appeals held that the appellee was entitled to compensation only for that portion of the land which was above the high water mark prior to filling. The court ruled that the state had title to the navigable waters and the soils under them regardless of whether certain portions of those waters were too shallow for navigation. The court also held that an individual cannot acquire title by artificially filling in submerged lands. In addition, the right to make such fills exists only for the purpose of reaching deep navigable water. Such was not the purpose in this case. (Gabrielson-Fla)
W69-06628

STATE V KIVETT (SUIT TO ENJOIN PRIVATE MINING OF STATE-OWNED RIVER BEDS).

95 NE 2d 145-153 (Ind 1950).

Descriptors: *Indiana, *Navigable waters, *Ownership of beds, *Rivers, Navigation, Judicial decisions, Damages, Permits, Dredging, Mining, Legal aspects, State governments, Federal jurisdiction, Control, Regulation, Gravel, Sands.
Identifiers: Injunction (Prohibitory).

Defendant owned land on the White River and began to remove sand and other materials from the river bed. Defendant refused to secure a state permit to operate his drag line. Subsequently, the state brought action to enjoin defendant from taking the materials and for an accounting for all materials he had taken. The appellate court reversed the trial court's judgment for defendant. The court found the controlling issue to be the ownership of the river bed. It held that title to the particular portion of the bed in question was in the state. The court said the question of ownership depended upon whether the particular section of the river was navigable at the time the state was admitted to the Union; the determination of navigability was to be made by applying federal law. Under federal law, a river which is navigable in fact is navigable for all purposes. Evidence was sufficient to show navigability in fact at the time Indiana was admitted to the Union. The case was remanded for hearing on the question of damages. (Wheeler-Fla)
W69-06629

WATER SUPPLY DISTRICTS.

N J Stat Ann secs 58:5-16, 58:5-19, 58:5-27, 58:5-36 (1966).

Descriptors: *New Jersey, *Water districts, *Water supply, *Contract administration, Legal aspects, Legislation, Maintenance, Construction, Costs, Facilities, Condemnation, Canals, Cities, Municipal water, Reservoirs, Administrative agencies, Contracts, Operation and maintenance, Local governments, Water rights, Regulation, Water works.

The district water supply commission shall have the power to acquire all existing water rights and distribution systems owned by existing corporations or municipalities which are necessary to carry out the execution of water supply contracts. The commission has the power to acquire by purchase or condemnation all property necessary for construction or operation of a water supply network. The power to construct all facilities necessary to provide contracting municipalities in the water supply district with a sufficient water supply is also given to the commission. The commission may acquire by agreement, purchase, or condemnation, from any canal corporations, the water rights necessary for its reservoirs. Municipalities within a water supply district may not extend their existing water supply network without the consent of the commission. The commission shall have the power to: (1) maintain and use water transmission facilities; (2) acquire any property deemed necessary for such facilities; and (3) enter into any agreements necessary to carry out any power conferred by this act. The commission shall not have the power to condemn municipal water works. (Holt-Fla)
W69-06630

ICE DEALERS; BATHING; WATER SUPPLY FOR RURAL FIRE PROTECTION.
N J Stat Ann 58:7-1 to 58:9-1 (1966).

Descriptors: *New Jersey, *Ice, *Swimming, *Navigation, Legal aspects, Legislation, Public rights, Relative rights, Riparian rights, Dams, Beds under water, Local governments, Ownership of beds, Navigable waters, Right-of-way, Fresh water, Judicial decisions, Alteration of flow, Hydrants, Ponds.
Identifiers: *Fire protection, *Ice dealers.

All persons with ice houses on the waters of this state may gather ice to the middle of the water body upon which they are located. No persons shall interfere with such gathering of ice except for purposes of navigation. The right to gather ice does not extend to owners of mill ponds nor to parties having a mere right-of-way upon the shore of the state's watercourses. Persons may bathe or swim in any fresh waters of the state so long as no trespass is thereby committed. Any governing body in the state may alter stream beds and construct dams, fire hydrants, or obtain any other necessary equipment in order to provide adequate rural fire protection. (Harris-Fla)
W69-06631

SEWERAGE DISTRICTS AND BOARDS.
For primary bibliographic entry see Field 05G.
W69-06632

SEWERAGE DISTRICTS AND BOARDS.

N J Stat Ann secs 58:12-24 to 58:12-28 (1966).

Descriptors: *New Jersey, *Sewage districts, *Construction, *Drainage systems, Legislation, Water law, Planning, Water policy, Condemnation, Sewage disposal, Cities, Roads, Grading, Drainage programs, Administrative agencies, Alteration of flow, Operation and maintenance, Sewers, Real property.
Identifiers: *Channel alteration, Intercepting sewers.

Any incorporated board may, within its respective district, construct, maintain, and operate a sewerage and drainage system. All parties owning or controlling such sewerage and drainage systems shall provide for their connection to existing or proposed intercepting or main sewers. Any lands necessary for the construction of sewers, drains, or disposals may be acquired by purchase or condemnation by the board. The board is authorized to enter upon any land for survey purposes providing no unnecessary damage is done to private or other property. The board is given the power to construct the sewers in any place they deem necessary provided they do not impede navigation or travel and provided they restore all roads and streets to their conditions prior to construction. For constructions outside of the sewer district, consent from the governing body of the municipality is required. The board has the power to change the course or direction of any watercourse, and, with consent of the controlling body, to alter the grade of highways and streets. (Holt-Fla)
W69-06633

JURISDICTION OVER WATERS.

Minn Stat Ann secs 1.02, 1.03, 1.044, 1.12 (1946), as amended, (Supp 1968).

Descriptors: *Minnesota, *Wildlife, *Jurisdiction, *Bodies of water, Shores, Mississippi River, Wildlife conservation, Fish conservation, State jurisdiction, United States, Legislation, Easements, Right of way, Highways, Flow, Public benefits, State governments, Federal government, Interstate rivers, Interstate, Projects, Boundaries (Property), Lakes, Rivers.

All courts currently exercising jurisdiction over Big Stone Lake, Lake Traverse, Bois de Sioux River, or Red River of the North, shall continue to exercise jurisdiction in all civil and criminal cases involving such waters concurrently with the courts of other states bordering on such waters, so far as any of these waters form a common boundary between this state and any other state. The concurrent jurisdiction of the courts shall extend over such water areas as if the boundaries of the county were extended to the opposite shore. The state gives consent to the United States to acquire lands and water within the state for use in the establishment of the Upper Mississippi River Wild Life and Fish Refuge. The state maintains jurisdiction over the area as long as such retention is not inconsistent with the purposes of the United States in establishing the preserve. The state may convey to the United States any easement for flowage owned by the state for trunk highway right of way purposes when it shall be required by the United States for public improvement. (Shevin-Fla)
W69-06634

CERTAIN GAME PRESERVES, AREAS, PROJECTS; CONTROL.
Minn Stat Ann sec 84A.55 (1964).

Descriptors: *Minnesota, *Public lands, *Conservation, *Land management, Drainage, Land development, Forests, Recreation, Fishing, Hunting, Wildlife, Land use, Camping, Regulation, Legislation, Land resources, Parks, Wildlife conservation, Forest management, Natural resources, Condemnation, Administrative agencies, Construction, Maintenance, Eminent domain.
Identifiers: Game preserves.

The Commissioner of Conservation shall manage, operate, and control all game preserves, areas, and projects established by sections 84A.01, 84A.20 or 84A.31 of the Minnesota Statutes. The powers and duties of the Commissioner are: (1) care of the forests and fire prevention; (2) sale of timber; (3) regulation of the waters of lakes and streams; (4) protection of wildlife; (5) issuance of hunting, fishing, and camping licenses; (6) policing of the game preserves; (7) investigations and surveys for and construction of drainage projects on state land; (8) construction and maintenance of roads and landing fields; and (9) promulgation of rules and regulations for the execution of his duties and powers. Nothing shall be done under this Act which will interfere with or damage any ditch, road, or highway of any governmental subdivision, agency, or person unless just compensation is paid. The Commissioner may acquire by purchase or condemnation any land, public work, or project necessary for any authorized purpose. (Helwig-Fla)
W69-06635

PETITION OF MARTIN (OBSTRUCTION TO NAVIGATION).

102 F Supp 43-51 (E D Pa 1951).

Descriptors: *Pennsylvania, *Navigation, *Admiralty, *Navigable waters, Rivers, Shallow waters, Ships, Boats, Damages, Remedies, Judicial decisions, Permits, Federal government, Legal aspects, Channels, Streambeds, Piers.
Identifiers: *Cables, *Obstruction to navigation.

Because of emergency conditions, respondant received a government permit to lay untrenched power cables across the bottom of a navigable river. Petitioner's tugboat, while executing a necessary and orthodox maneuver 100 feet off of the end of respondant's pier, struck and damaged some of those cables. Petitioner sought an exemption from and limitation of liability resulting from the collision. The court granted the petition. It held that the right of a vessel to operate in navigable waters free from obstructions was paramount to the right of the owner of unentrenched cables lying beneath the surface. The permit from the proper governmental agency allowing the cables to be laid unentrenched did not alter petitioner's rights. In laying the unentrenched cables, respondant assumed the risk that vessels operating on the navigable waterway might collide with the cables in the shallow waters off respondant's pier. The court could not find the tugboat captain negligent in assuming the power cables would be located a safe distance below the soft mud bottom in waters where his vessel could navigate. (Gabrielson-Fla)
W69-06636

SOUTHERN TRANSPORTATION CO V CITY OF NEW YORK (NEGLIGENCE OF BRIDGE OPERATOR AND TUG MASTER CAUSING BARGE COLLISION).

98 F Supp 967-972 (SD NY 1950).

Descriptors: *New York, *Bridges, *Navigation, *Cities, Abutments, Currents (Water), Transportation, Piers, Judicial decisions, Inland waterways, Mechanical equipment, Boats, Navigable waters, Warning systems, Damages, Streams.
Identifiers: *Barges, *Tug boats.

A barge owner filed suit against the city, as bridge owner and operator, and against certain steamtug owners to recover for damage to its barge sustained in a collision with a bridge abutment. Plaintiff alleged that city's bridge operator was negligent in failing to open the bridge upon timely signal and that defendants' steamtug, towing the barge, was operated at an excessive speed and negligently lost control of its tow, causing it to sheer into the bridge abutment. The court stated that a bridge spanning a navigable body of water is an obstruction to navigation and that bridge operators have duty to open bridge promptly upon signal from vessels desiring passage. The record showed that, while bridge operator must have heard tug's signal, he failed to open the bridge or give warning that it would not open. This failure to open was ruled a fault contributing to the collision. Furthermore, the court held the tug's continued movement toward the bridge at full speed, when, in a reasonable view of the situation, it was apparent that the bridge was not opening, was a contributing cause of the collision for which its owners, with city, would be held liable for damages. (Reed-Fla)
W69-06638

OWEN V JOHNSON (OWNERSHIP OF THE BED OF A NAVIGABLE STREAM).

263 SW 2d 480-482 (Ark 1954).

Descriptors: *Arkansas, *Navigable waters, *Riparian rights, *Boundaries (Property), Ownership of beds, State governments, High water mark, Legal aspects, Judicial decisions, Real property, Watercourses (Legal), Beds.
Identifiers: Adverse possession.

In an action to quiet title, plaintiff asserted ownership of certain lands acquired by adverse possession and by certain recorded deeds. Defendants also claimed title to the 3.5 acre tract. A town and the Commissioner of state lands intervened claiming interests in certain part of the land. The supreme court upheld the trial court's judgment for plaintiff as against defendant and the town. As to the claims of the state, the court took judicial notice that White River was a navigable stream where it bordered plaintiff's land. Consequently plaintiff owned only to the high water mark. Title to the beds was in the state. (Harris-Fla)
W69-06639

ERICKSON V GREUB (TITLE TO ACCRETION).

287 SW 2d 873-876 (Mo 1956).

Descriptors: *Missouri, *Erosion, *Erosion control, *Accretion (Legal aspects), Missouri River, Bank erosion, Boundaries (Property), Dikes, Retaining walls, Stream improvement, Federal government, Riparian rights, Judicial decisions, Remedies, Legal aspects, Relative rights, Real property, Islands.

Plaintiff brought action to quiet title to a 40 acre tract on the west bank of the Missouri River. Previously a large portion of the tract had been eroded by the swift flowing river currents. However, following government construction of retaining walls and dikes, a process of accretion began which culminated in the formation of an island which eventually became attached to what had been the west bank of the river. Defendant, who owned property adjacent to plaintiff's tract, claimed title to this land, alleging that plaintiff's entire tract had washed away and that the accretion had formed on land which, in reality, belonged to the defendant. The trial found that one small corner of plaintiff's land had not washed away and entered a judgment for plaintiff. Defendant appealed. The appellate court affirmed the lower court's decisions, holding that accreted land belongs to the person who owns the land to which the accretions become attached. Since the trial court found that defendant's land was separated from the accreted land by plaintiff's land, the accretion could not have been to defendant's land. (Gabrielson-Fla)
W69-06641

EMINENT DOMAIN.
Minn Stat Ann secs 117.01, 117.38 to 117.47 (1967).

Descriptors: *Minnesota, *Legislation, *Eminent domain, *Riparian rights, Cities, Conservation, Mining, Land tenure, Road construction, Drainage systems, Federal government, State governments, Condemnation, Easements, Alteration of flow, Judicial decisions, Industries, Transportation.
Identifiers: *Taconite mining.

The taking of private property for public purposes shall be by power of eminent domain, unless the taking relates to laws concerning roads and drainage, where the law prescribes a specific procedure. When any governmental authority authorizes any change in any watercourse in Minnesota, any company licensed to transport freight or passengers may acquire lands needed to improve its property as necessitated by such changes. The acquisition may be either by purchase or condemnation by right of eminent domain, but any interested municipality may question the necessity for condemnation. Upon acquiring title, the corporation shall convey them to the governmental authority. An award of compensation for condemnation confirmed by a city shall be paid only to one showing a right to it and only under such conditions as the city shall deem proper. The Commissioner of Conservation and any corporation or association mining or beneficiating taconite or semitaconite are authorized to acquire property or water rights by eminent domain to facilitate operations or shipping. The Commissioner of Conservation may grant permits or leases on or across lands, and may license the flooding of state lands in connection with legislative authorization to use public waters. (Harris-Fla)
W69-06642

HAYNES V SMITH (PRIVATE COMMERCIAL VENTURES ON PUBLIC WATERS).

85 So 2d 326-332 (La Ct App 1956).

Descriptors: *Louisiana, *Commercial fishing, *Ownership of beds, *Marinas, Judicial decisions, Fishing, Freshwater fish, Riparian land, Riparian rights, Water supply, Water rights, Recreation, Boats, Lakes, Public health, Sanitation, Public lands, Lakes, Appropriation, Administrative agencies, Construction, Cities.
Identifiers: Injunctions (Prohibitory).

Plaintiffs, lakeshore owners, brought suit to enjoin construction of a commercial fishing camp on nearby lakeshore property. Plaintiffs contended that defendant had no legal right to engage in a private commercial venture on waters which were held in trust for the public. Such venture would constitute an illegal appropriation of public property for a private purpose. In addition, plaintiffs contended that the fish camp would constitute a nuisance because of noise and conjestion. Finally, plaintiffs claimed that lake had been dedicated to the city as a municipal water source and that this dedication precluded any other use. The court found that the only basis for the plaintiffs' objection was their desire to enjoy a completely private and restricted area. Consequently, a judgment for the defendant was affirmed. The court ruled that the defendant had obtained permission from the proper authorities and that there were no restrictions affecting the use of the lake for private commercial ventures. (Stewart-Fla)
W69-06643

CARNASION V PAUL (RIGHT OF A COUNTY TO TAX TIDELAND PROPERTY).

53 So 2d 304-306 (Fla 1951).

Descriptors: *Florida, *Taxation, *Piers, *Navigable waters, Atlantic Ocean, Coastal structures, Concrete structures, Tides, Seashores, Low water mark, Tidal waters, Federal government, Federal-state water rights conflicts, State governments, Permits, Jurisdiction, Oil, Ownership of beds, Legal aspects, Judicial decisions, Local governments.
Identifiers: *Tidelands, Police power.

Appellee filed a bill in equity questioning the authority of the county to tax a pier constructed pursuant to a permit from the federal government. The pier was located below the low water mark of the Atlantic Ocean. Appellant contended that exclusive dominion over the tidelands was vested in the United States and therefore, these lands were beyond the taxing jurisdiction of the state. The court held that the exclusive dominion of the United States over the tidelands applied only to oil deposits beneath them. The court stated that the paramount right of possession was in the United States with a concurrent right of possession in the sovereign states to be exercised when not in conflict with the rights of the United States. The court held that the county had a right to tax the area by virtue of its police powers as long as such taxes did not conflict with the authority of the United States. (Shevin-Fla)
W69-06644

DAVIS V CITY OF ALEXANDRIA (PUBLIC USE OF LEVEE BANK AS ROADWAY).

69 So 2d 587-589 (La Ct App 1953).

Descriptors: *Louisiana, *Levees, *Cities, *Easements, Berms, Public rights, Riparian rights, Embankments, Legislation, Sewers, Banks, Roadbanks, Highways, Engineering structures, Meanders, Rivers, Right of way, Maintenance.
Identifiers: *Public servitudes.

Plaintiff brought suit to prevent the city of Alexandria from using a roadway crossing plaintiff's property on the berm of a river levee bank or in the alternative, to recover compensation for the city's alleged appropriation of said roadway. A portion of plaintiff's lot was occupied by a levee, at the toe of which was a strip of ground following the meanders of the levee. Defendant alleged that this strip had been used as a public street for many years. Defendant further asserted that the roadway was a public highway before being included within the city limits, and that there had never been any appropriation by the city. The roadway in question was built on the levee berm, that is, on the embankment superimposed on the natural ground toward the levee proper. The court observed that a state statute provided that public servitudes relate to the space to be left by the adjacent proprietors on the shores of navigable rivers for public use and for the making and repairing of levees. The court held that, under the provisions of this law, the city had the right of public passage, and plaintiff could not prevent the use of the embankment as a roadway. Since this land was subject to a public servitude, plaintiff was not entitled to compensation. (Reed-Fla)
W69-06645

EARLE V MCCARTY (TITLE TO LAND BETWEEN SOUND AND DEDICATED ROAD).

70 So 2d 314-317 (Fla 1954).

Descriptors: *Florida, *Proprietary power, *Land tenure, *Boundaries (Property), Cities, Accretion (Legal aspects), Atlantic Ocean, Legislation, Right of way, Navigable waters, Rivers, Access routes, Roads, Public rights, Beds, Legal aspects, Surveys, Land forming.
Identifiers: *Abandonment, *Dedication, Plats.

The owner of a lot bounded on east by the sea and on west by a street brought suit to determine title to land which was not platted and which was situated to the west of the street. Plaintiff alleged that, although his grantor had dedicated the street to the public, such roadway had never been accepted by the city. Plaintiff further alleged that where a dedicated street is not accepted, or is abandoned, title reverts to abutting landowners. Thus, plaintiff argued that he owned the street together with the dedicated, but unaccepted, land in controversy. The tract had greatly increased in size due to accretion. Plaintiff's lot had disappeared under the ocean. The court declared that the dedication of the street must be deemed to have been 'accepted' by the city upon its acceptance of grantor's deed to the street. Furthermore, the city cannot be said to have abandoned the street because of its failure to improve it; the need for improvement had never arisen. Finally, the court held that, even assuming abandonment of the street or nonacceptance of its dedication, the fact that this land did not appear on the plat indicated a reservation rather than a dedication by the grantor. Therefore, plaintiff had no claim to the unmarked strip of land. (Reed-Fla)
W69-06646

FLOOD WALL BOARD.

W Va Code Ann sec 8-4A-21a (1966).

Descriptors: *West Virginia, *Flood control, *Administrative agencies, *Barriers, Obstruction to flow, Cities, Structures, Concrete structures, Flood protection, Flood routing, Floodwater, Regulation, Supervisory control (Power), Legislation, Local governments, Operation and maintenance, Taxes, Financing, Assessments, Costs.
Identifiers: *Flood walls.

Municipal authorities may provide by ordinance that the custody, administration, operation, and maintenance of flood walls shall be under the supervision and control of a flood wall board. Any such ordinance enacted may not later be repealed or amended in such a manner as to impair or defeat the purposes for which it was enacted. The board may establish rules and regulations but are not empowered to levy or collect ad valorem or other taxes or assessments. Municipal authorities are to provide adequate funds to the board. (Wheeler-Fla)
W69-06647

HAMMEL V CAMP RANGER, INC (PRESUMPTIONS REGARDING CONVEYANCE OF INLAND, NON-NAVIGABLE POND).

87 NYS 2d 892-899 (App Div 1949).

Descriptors: *Land tenure, *Ponds, *Boundary disputes, *Boundaries (Property), Judicial decisions, Legal aspects, Ownership of beds, Water level fluctuations, Low water mark, Banks, Recreation, Adjudication procedure, Water rights, Remedies.
Identifiers: *Evidence, Suit to quiet title, Rebuttable presumptions.

The defendant appealed from an adverse ruling below concerning title to a portion of land claimed by both litigants. The lower court determined that the phrase 'the said premises to run along the said Pleasant Pond, and to the low water mark thereof,' contained in defendant's deed, indicated that the defendant did not have title to the pond itself. The supreme court reversed, stating that the law of New York requires that the terms of a grant be liberally construed in favor of the grantee, especially as to a grant of land on a small inland body of water. A strong presumption arises in cases such as this one that the grantor intended to convey ownership under water at least to the center of the pond. Nothing short of express language to the contrary will overcome the force of this presumption. The dissent vigorously contended that the presumption was overcome by the express terms of deed. (Katz-Fla)
W69-06648

ELDER V DELCOUR (MISSOURI ADHERES TO STRICT TEST OF NAVIGABILITY IN DETERMINING TITLE TO RIVER BED).

269 SW 2d 17-27 (Miss 1954).

Descriptors: *Mississippi, *Ownership of beds, *Navigable waters, *Non-navigable waters, River beds, Riparian rights, Streambeds, Public rights, Legal aspects, Judicial decisions, State jurisdiction, Water rights, Wildlife, Obstruction to flow, Barriers, Streams, Damages, Remedies, Fishing, Fish.
Identifiers: Meramec River, Declaratory judgment.

Plaintiff brought this action for a declaratory judgment to determine the rights of the general public to float down and fish in a river flowing across defendant's farm. The supreme court determined that title to a submerged river bed remains in the public domain as long as the river is used as a highway for commerce and travel. The court found the river to be nonnavigable in the sense that it was not used for commerce or travel and declared that defendant had title to the submerged bed. The title was not absolute, but subject to the burdens imposed by the river itself. Though the river was not navigable in the sense that title to the bed would remain in the public domain, the court held that it was navigable in fact and that defendant's title was subject to a public easement for purposes of navigation. It was also determined that the right to fish in the stream was incident to the right of navigation as title to fish in the stream remains in the state until they are reduced to possession. (Katz-Fla)
W69-06649

SKALITSKY V CONSOL BADGER CO-OPERATIVE (OWNERSHIP OF FILLED POND BED).

252 Wisc 132, 31 NW 2d 153-155 (1948).

Descriptors: *Wisconsin, *Ownership of beds, *Boundary disputes, *Landfills, Judicial decisions, Boundaries (Property), Backwater, Bodies of water, Damages, Proprietary power, Pipes, Streambeds, Shores, Relative rights, Legal aspects, Great ponds, Cities, Land forming, Ponds.

Plaintiffs acquired land along the shoreline of an artificially created pond. Later, by quit-claim deed, a city acquired a strip of the pond bed. A portion of the city's tract bordered on plaintiff's land. After filling in the bed, the city permitted defendant to lay pipes across the filled land for the purpose of supplying water to defendant's industrial plant. Plaintiffs brought suit to void the city's title, to compel removal of the structures, and for damages. Plaintiffs alleged that they owned the filled in land bordering the original shoreline of their lot. This claim was based on the rule that when one purchases land bordering on a stream, he takes title to the stream's thread unless otherwise provided. The appellate court affirmed the lower court's dismissal. The court ruled plaintiffs' grantors did not intend to convey title to the bed, and since plaintiffs had no title to the filled land they had no right of action. The court noted that plaintiffs' land did not border a stream; it bordered a pond, which had no thread. The court also stated that title to the bed rests on title to the bed itself, not on title to the bank. (Wheeler-Fla)
W69-06650

HANCOCK V STULL (INTERFERENCE WITH NATURAL DRAINAGE OF SURFACE WATER).
86 A 2d 734-736 (Md 1952).

Descriptors: *Maryland, *Obstruction to flow, *Surface drainage, *Natural flow, Surface waters, Surface runoff, Rainwater, Drainage effects, Drainage systems, Judicial decisions, Drainage water, Repulsion (Legal aspects), Relative rights, Alteration of flow, Storms, Remedies, Walls, Engineering structures, Diversion.

Plaintiff sought to have defendant enjoined from maintaining a wall which diverted the natural flow of surface waters onto plaintiff's land. Plaintiff admitted that he had placed a wall in the course of the natural surface flow, and that this caused concentrated amounts of surface water to flow onto defendant's land. The court held that the construction of the wall so as to divert the flow onto plaintiff's land was an invasion of plaintiff's rights. The fact that plaintiff increased the flow onto defendant's land was not sufficient cause to deny plaintiff relief. Appropriate relief, including removal of portions of the wall should be conditioned on plaintiff's rectification of his own wrongdoing. An agreement between adjoining landowners with respect to diversion of surface waters naturally flowing across the rear of their lots must be made by the landowners and not by the court. (G Kelly-Fla)
W69-06652

NASSAU COUNTY V CHERRY VALLEY ESTATES (LANDOWNERS RIGHT TO PREVENT FLOW OF SURFACE WATER ONTO HIS PROPERTY).
281 App Div 692, 117 NYS 2d 616-617 (1952).

Descriptors: *New York, *Surface drainage, *Drainage systems, *Obstruction to flow, Water law, Legal aspects, Judicial decisions, Topography, Surface waters, Cities, Surface runoff, Repulsion (Legal aspects), Riddance (Legal aspects), Relative rights, Remedies.

Plaintiff town had constructed a drainage system which collected surface water in an area north of defendants' land and channeled it into a watercourse the source of which was on defendants' property. Defendants filled in the watercourse to prevent surface water from flowing onto its land. This obstruction caused a stagnant pool of water to form which was claimed to be a public nuisance. Plaintiff sought to have the channel restored. The court held that defendants had the right to improve their property by preventing the flow of surface water onto their land. (Holt-Fla)
W69-06653

SAVOIE V TOWN OF BOURBONNAIS (PRESCRIPTIVE RIGHTS).
339 111 App 551, 90 NE 2d 645-652 (1950).

Descriptors: *Illinois, *Repulsion (Legal aspects), *Prescriptive rights, *Riddance (Legal aspects), Ditches, Easements, Drainage water, Runoff, Overland flow, Diversion, Natural flow doctrine, Precipitation excess, Rain water, Storm runoff, Legal aspects, Judicial decisions, Real property, Cities, Relative rights, Damages.
Identifiers: Injunctions (Mandatory).

Plaintiff brought suit to recover damages and to secure a mandatory injunction compelling defendants to repair and maintain a drainage ditch located on defendant's property. The ditch had previously diverted waters from plaintiff's land. The plaintiff contended that the defendant town, by allowing the ditch to deteriorate, had violated his prescriptive right of forty years which entitled him to be relieved from the natural flowage of surface waters over his property. The court recognized that such a right may be prescriptively acquired against a municipality if that body is engaged in a private, nongovernmental capacity with relation to the right involved. If such a right had been established, it merely imposed a duty on the municipality not to restore the original watercourse to its natural state by a wrongful overt act; implying that the municipality could otherwise restore same. Plaintiff argued that the individual defendants had created a mutual ditch which under statute created a vested interest in all benefited landowners and that the defendants should be liable for the costs of restoring the ditch. The court noted that the statute was silent as to the burden of repair of such a ditch and that the plaintiff was merely an incidental beneficiary without vested rights concerning the ditch. (Katz-Fla)
W69-06655

RAU V WILDEN ACRES, INC (DIVERSION OF NATURAL FLOW BY ARTIFICIAL CHANNEL).

376 Pa 493, 103 A 2d 422-424 (1954).

Descriptors: *Pennsylvania, *Natural flow doctrine, *Diversion, *Discharge (Water), Surface runoff, Surface drainage, Diversion structures, Diffusion, Ditches, Legal aspects, Flow augmentation, Judicial decisions, Surface waters.
Identifiers: Injunctions (Prohibitory).

Plaintiff landowner brought action to restrain the owner of higher, neighboring land from artificially draining surface water from his property onto that of plaintiff. The governing principle of law in such a situation is that a landowner may not alter the natural flow of surface water on his property by concentrating it in an artificial channel and discharging it upon the lower land of his neighbor, even though no more water is thereby collected than would naturally have flowed upon neighbor's land in a diffused condition. The court found that evidence sustained findings that defendant diverted the natural flow of water from its property onto and over plaintiff's field by concentrating the water at an ar-

tificial point of flow and by cutting a ditch. Since the natural flow of water, in the absence of defendant's acts, would have been naturally diffused and dissipated in the main into a low point, or hollow, upon defendant's own premises, plaintiff was entitled to a cease and desist order. (Reed-Fla)
W69-06656

RINZLER V FOLSOM (ARTIFICIAL INCREASE OF SURFACE RUNOFF).

209 Ga 549, 74 SE 2d 661-665 (1953).

Descriptors: *Georgia, *Discharge (Water), *Natural flow doctrine, *Surface runoff, Overland flow, Overflow, Rain, Culverts, Mole drainage, Dikes, Floodwater, Saturation, Water spreading, Storm drains, Domestic wastes, Water pollution, Drainage systems.
Identifiers: *Freshets, Injunctions (Mandatory).

Plaintiff, owner of an improved lot brought action against the owners of the upper adjoining lot to restrain them from increasing, by artificial means, the natural flow of surface waters running across their lot onto the plaintiff's lot. The governing principle of law in such situations is that where the owner of the higher lot constructs and maintains culverts and embankments to control the flow of surface waters over his lot, he is under a duty to lower lot owners to construct and maintain such culverts and embankments so that the accumulation of waters from freshets will not cause breaks in the embankments and inundate lots of lower landowners. Therefore, the granting of an inter-locutory injunction restraining defendants from increasing, by artificial means, the natural flow of surface waters across their lot onto plaintiff's lot was not an abuse of discretion. There was ample evidence of the inadequacy of the retaining wall and storm sewer to handle the increased flow of surface waters due to the construction of apartment houses and paved driveways on defendant's land. (Reed-Fla)
W69-06657

ADKINS V HUGHES (BOUNDARY DISPUTE DUE TO AVULSION).

239 SW 2d 253-255 (Ky 1951).

Descriptors: *Kentucky, *Boundary disputes, *Accretion (Legal aspects), *Streams, Judicial decisions, Legal aspects, Stream erosion, Boundaries (Property), Rain avulsion, Real property, Land tenure.
Identifiers: Questions of fact, Deeds.

Plaintiffs brought suit in ejectment to recover land which was located on the defendants' side of a creek which was the designated boundary between the properties in the original deeds. The parties stipulated that the verdict should be for the plaintiffs if it was shown that the creek had taken a sudden change in course subsequent to the date of the deeds; if the change in the course was due to a gradual wearing away, the verdict was to be for the defendants. The jury found for the plaintiff. The court of appeals of Kentucky affirmed the decision of the trial court on the grounds the evidence supported the finding of the jury that the change in the creek course had been sudden. (Watson-Fla)
W69-06658

HUGHES V KNIGHT (RIGHT TO UNOBSTRUCTED DRAINAGE OF SURFACE WATERS).

33 NJ Super 519, 111 A 2d 69-72 (App Div 1955).

Descriptors: *New Jersey, *Dams, *Prescriptive rights, Surface waters, Flow augmentation, Damages, Water spreading, Legal aspects, Culverts, Drainage effects, Drainage water, Natural flow doctrine, Drainage, Obstruction to flow, Alteration of flow, Judicial decisions.
Identifiers: Servient estates, Dominant estates, Injunctions (Mandatory), Injunctions (Prohibitory).

Plaintiff brought action to enjoin maintenance of a dam across a watercourse carrying surface waters from lands of plaintiff. Both parties demanded compensatory damages for alleged injury to their respective lands. The governing principle of law in such a situation is that where a channel for surface waters was created by cooperating forces of nature and exertions of man more than 40 years ago, plaintiff upper landowner became the owner of a dominant tenement to which the right to flow surface waters attached, and defendant lower owners became the owners of the servient tenement upon whom the obligation to respect this right devolved. Plaintiff, as the upper proprietor, cannot be denied relief on the basis of the 'clean hands doctrine' since, even though he went upon defendants' lands and enlarged the ditch, these acts were not done insolently and in defiance of any contemporaneous protest by defendants. Thus, the court restrained plaintiff from draining through the ditch such an increased volume of water as would cause any additional material injury to defendant's lands; defendants were commanded to remove the dams constructed by them on their property. (Reed-Fla)
W69-06660

SEWERS AND DRAINS: PRIVATE DRAINS.

Me Rev Stat Ann tit 30, secs 4401-4408 (1965); Me Rev Stat Ann tit 30, secs 4401A, 4402A, 4403 (Supp 1968-69).

Descriptors: *Legislation, *Maine, *Drainage systems, *Permits, Subsurface drainage, Drainage water, Drainage programs, Sewers, Local governments, Cities, Drainage districts, Construction, Cost allocation, Cost-benefit analysis, Compensation, Legal aspects, Legislation, Regulation, Public benefits, Financing.

A person is authorized to connect his private drain into any public drain or sewer while the public drain is under construction. However, he must first obtain a permit from the proper authorities. After the public drain has been completed, no person shall connect his private drain until he has paid an assessment and received a permit. However, the above provisions shall not apply to any municipality until accepted by the inhabitants or government of the municipality. In addition, the statute provides that any connection made without a permit may be destroyed. Furthermore, if a person violates any provision of his permit, his drain may be disconnected and his permit forfeited. The statute describes the procedure to be used in applying for a permit. (Stewart-Fla)
W69-06661

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
38 Me Rev Stat Ann secs 611-854 (1965).

Descriptors: *Maine, *Legislation, *Mill dams, *Adjudication procedure, State governments, Reasonable use, Hydraulic structures, Canals, Conveyance structures, Streams, Water level fluctuations, Flooding, Overflow, Eminent domain, Condemnation, Damages, Remedies, Riparian lands, Riparian rights, Diversion loss returns, Riparian waterloss, Competing uses, Legal aspects, Regulation, Rivers.

Mills, and dams erected in conjunction with mills, within the state and on rivers constituting a state boundary are subject to this act. Liability of mill owners, occupiers and lessees for damages resulting from overflow of waters kept for milling purposes is set forth in detail. Subject to certain regulations, water may be diverted from any nonnavigable stream for use in mill dams. A mill owner cannot make unreasonable use of stream waters to the detriment of lower riparian owners, nor can he maintain a reservoir level detrimental to other riparian owners. While recognizing the privilege of dam owners to inundate riparian lands along a stream, the act requires adequate and reasonable compensation to be paid therefor. Procedure is provided whereby annual damages to property may be assessed by judgment of the court or by appraisal by local county commissioners. The mill owner is required to furnish security for the annual damage payment and failure to tender payment enables the complaining owner to impress a lien on the mill or dam. (Katz-Fla)
W69-06662

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
38 Me Rev Stat Ann, secs 651-655 (1965).

Descriptors: *Maine, *Legislation, *Mill dams, State governments, Reasonable use, Hydraulic structures, Canals, Conveyance structures, Streams, Water level fluctuations, Flooding, Overflow, Damages, Remedies, Riparian lands, Riparian rights, Legal aspects, Impounded waters, Embankments, Diversion, Alteration of flow, Land tenure, Compensation, Nonnavigable waters.

Any person may erect and maintain on his own land a water mill and dams upon and across any nonnavigable stream. Any person may cut a canal or raise embankments upon his land and divert water from its natural channel provided that the canal does not exceed one mile in length and provided that he is the owner of all riparian rights between the point of diversion and the point at which the waters are returned to the stream. A dam may not be constructed or erected to the injury of any mill site on which a mill has been erected and used unless the right to maintain such a mill has thereon been lost or defeated. The height to which the water level in these working ponds, the length of time during which such water may be impounded, and the amount of water that may be diverted by a canal may be restricted and regulated by jury verdict or report of the commissioners. Any person who sustains damage from excess mill dam flowage or by diversion of water by a canal shall obtain just compensation by application to the county court where any part of the lands are located. (Katz-Fla)
W69-06663

GENERAL PROVISIONS, REGULATING TO RIVERS AND STREAMS.
38 Me Rev Stat Ann secs 701-707 (1965).

Descriptors: *Maine, *Legislation, *Mill dams, *Adjudication procedure, State governments, Reasonable use, Hydraulic structures, Canals, Conveyance structures, Streams, Water level fluctuations, Flooding, Overflow, Eminent domain, Condemnation, Damages, Remedies, Riparian lands, Riparian rights, Diversion loss returns, Compensation riparian waterloss, Competing uses, Legal aspects, Assessments, Administrative agencies.
Identifiers: Complaints, Causes of action, Court costs, Attorney's fees, Default judgments.

A complaint for damages to land overflowed by backwater from a mill dam shall contain a description of the land and a statement of damage. Service of such a complaint shall be made as in other civil actions. The defendant owner of a mill or canal may assert every and any available defense against the plaintiff but he may not answer that the land described is not injured by such dam or canal. All issues raised in such suits shall be decided as similar issues are decided at common law. If judgment is for defendant, he shall recover his costs. If the issue is decided in favor of plaintiff or if defendant is defaulted, the court shall appoint 3 or more disinterested county commissioners who shall go upon the land, appraise the damages, and report a sum as reasonable compensation in gross for such damage and shall estimate a fair sum for the right of maintaining such a dam forever. Annual damages may be determined by judgment of the court, subject to the right of the owner of the dam or mill to appeal to the court by new complaint for assessment in gross

by commissioners. Payment in gross by the owner shall be a bar to future action so long as the dam height is not raised. (Katz-Fla)
W69-06664

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.

38 Me Rev Stat Ann sec 708-712 (1965)

Descriptors: *Maine, *Legislation, *Mill dams, *Adjudication procedure, State governments, Reasonable use, Hydraulic structures, Canals, Conveyance structures, Streams, Water level fluctuation, Flooding, Overflow, Eminent domain, Condemnation, Damages, Remedies, Riparian lands, Riparian rights, Diversion loss returns, Riparian waterloss, Competing uses, Legal aspects, Administrative agencies.
Identifiers: Trials, Evidence.

The report of the commissioners as to the damage to complainant's property is admissable as evidence before a jury, and such report cannot be refuted except by showing misconduct by some commissioner. If neither party requests a trial by jury, the commissioners' report may be accepted by the court and a judgment rendered thereon. The verdict of the jury or the report of the commissioners so accepted is a bar to further action for such damages and shall be the measure of yearly damages between the parties until a new complaint is filed by either party. Whenever an action is brought to ascertain or increase damages, the complainant may request the court to require the defendant to furnish security for yearly damages. (Katz-Fla)
W69-06665

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.

38 Me Rev Stat Ann secs 713-719 (1965).

Descriptors: *Maine, *Legislation, *Mill dams, *Adjudication, Procedure, State governments, Reasonable use, Hydraulic structures, Canals, Conveyance structures, Streams, Water level fluctuations, Flooding, Overflow, Eminent domain, Condemnation, Damages, Remedies, Riparian lands, Riparian rights, Diversion loss returns, Flood damage, Riparian waterloss, Competing uses, Legal aspects, Interest rate, Compensation.
Identifiers: Liens, Execution.

A party entitled under this act to annual compensation for flowage damage may maintain a civil action to enforce collection of the sum due with costs. Procurement of a favorable judgment shall give rise to a lien enforceable against the mill, canal, or milldam complained of and the land thereunder. The judgment may be executed at any time within 30 days by public auction as in selling an equity of redemption. Any person entitled to the premises may redeem them within one year after the sale by paying the purchaser or his grantee the sum paid therefor with interest of 12%. Whenever any party is dissatisfied with the annual compensation established, a new complaint may be filed provided that no new complaint shall issue until one month after the preceding year's payment is due. If the dam owner offers to increase future compensation for damages and the landowner does not accept it but brings suit to recover more damages, the land owner can only recover costs if he is awarded increased damages in an amount greater than that offered by the dam owner. The owner of injured land may offer to accept reduced compensation and the dam owner will not recover costs if he brings suit and is awarded a reduction less than offered. (Katz-Fla)
W69-06666

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.

38 Me Rev Stat Ann secs 720-725 (1965).

Descriptors: *Maine, *Legislation, *Mill dams, *Adjudication procedure, State governments, Reasonable uses, Hydraulic structures, Canals, Conveyance structures, Streams, Water level fluctuation, Flooding, Overflow, Eminent domain, Condemnation, Damages, Remedies, Riparian lands, Riparian rights, Diversion loss returns, Riparian waterloss, Competing uses, Legal aspects, Compensation.
Identifiers: Default judgments.

Compensation agreements entered into between tenants are binding as to immediate parties but are not binding as to owners unless such owners consent thereto. Remedies available under this act supersede common law remedies for damages occasioned by the overflow or diversion of waters except as to enforcement of damage awards. If the use restrictions imposed by report of the commissioners or finding of the jury respecting flowage are violated, the injured party may collect double damages. Annual compensation agreements shall be recorded in the office of the clerk in which the judgment was rendered. No such agreement shall preclude filing of a new complaint. A defendant in an original action may tender damages to the court or may offer to be defaulted for a reasonable sum. (Katz-Fla)
W69-06667

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.

38 Me Rev Stat Ann secs 726-728 (1965).

Descriptors: *Maine, *Legislation, *Mill dams, *Adjudication procedure, State governments, Reasonable use, Hydraulic structures, Canals, Conveyance structures, Streams, Water level fluctuations, Flooding, Overflow, Eminent domain, Condemnation, Damages, Remedies, Riparian lands, Riparian rights, Diversion loss returns, Riparian waterloss, Competing uses, Legal aspects, Compensation, Taxes, Costs.

Causes of action for land damage or water diversion do not abate by the death of any party thereto but may be prosecuted or defended by surviving plaintiffs or defendants, or the executors or administrators of such deceased parties. If a judgment for the plaintiff is reversed, a new complaint may be filed within one year to recover damages sustained during the three years preceding the institution of the first complaint. Commissioners shall be awarded suitable compensation. The prevailing party shall recover costs except where expressly provided otherwise. (Katz-Fla)
W69-06668

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.

38 Me Rev Stat Ann secs 771-776 (1965).

Descriptors: *Maine, *Legislation, *Mill dams, *Adjudication procedure, State governments, Reasonable use, Hydraulic structures, Canals, Conveyance structures, Streams, Water level fluctuation, Flooding, Overflow, Eminent domain, Condemnation, Damages, Remedies, Riparian lands, Riparian rights, Riparian waterloss, Competing uses, Legal aspects, Highways, Cities, Administrative agencies, Cost sharing, Water zoning.
Identifiers: Water vents.

When the owners of water power for operating mills find that they cannot obtain the necessary head of water for operation without overflowing some highway or town, they may petition the county commissioners for permission to raise such ways and enlarge the water vent thereof. A hearing shall be held to consider the petition, and all parties shall be notified thereof. The Commissioners shall decide the extent which such highways are to be raised and vents enlarged and shall prescribe the manner in which the work is to be done. The commissioners may order the town to make the alterations prescribed, and, if the town fails to act, the plaintiff shall perform the alterations. The commissioners shall affix proportionate expenses for the construction. Any aggrieved party may appeal from the decision of the commissioners. (Katz-Fla)
W69-06669

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.

38 Me Rev Stat Ann secs 811-813 (1965).

Descriptors: *Maine, *Legislation, *Dams, *Mill dams, Adjudication procedure, State governments, Reasonable use, Hydraulic structures, Canals, Streams, Water level fluctuations, Flooding, Overflow, Condemnation, Damages, Remedies, Riparian lands, Riparian rights, Competing uses, Legal aspects, Compensation, Reservoirs, Discharge (Water), Hazards, safety, Impounded waters, Inspection.

Upon request by either the selectmen or assessors of any town, or upon request by the county commissioners or 10 resident taxpayers, the civil engineer appointed by the governor shall inspect any dam or reservoir and shall file a report as to the safety thereof with the governor. If the engineer finds the dam to be hazardous to person or property he shall order the owners to make immediate repairs and in default thereof shall enjoin use of such dam and may cause the impounded waters to be safely discharged. The engineer shall be compensated at the rate of $5.00 per day plus expenses, recoverable from the mill or dam owners should a hazard be found to exist. (Katz-Fla)
W69-06670

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.

38 Me Rev Stat Ann secs 851-854 (1965).

Descriptors: *Maine, *Legislation, *Mill dams, *Adjudication procedure, Safety, State governments, Reasonable use, Hydraulic structures, Canals, Conveyance structures, Streams, Flooding, Overflow, Eminent domain, Condemnation, Damages, Remedies, Riparian rights, Riparian lands, Riparian waterloss, Competing uses, Legal aspects, Operation and maintenance, debt, interest rate, publications, repairing.

If repairs are thought necessary, the owner of a mill or dam may apply to the justice of the peace to call a meeting of the owners to consider repairs. Notice to the owners may be by publication. At such a duly called meeting, the owners of at least a 50% interest in such mill or dam may authorize action to repair or rebuild the structure. If the authorizing owners are not reimbursed by the profits of the mill or the other owners within 6 months after completion of the work, they may charge % interest for each succeeding month that the debt remains outstanding. (Katz-Fla).
W69-06671

SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
For primary bibliographic entry see Field 06B.
W69-06725

REGIONAL PLANNING FOR WATER DEVELOPMENT IN THE WESTERN UNITED STATES - THE RELEVANCE OF AMERICAN EXPERIENCE FOR OTHER NATIONS,
For primary bibliographic entry see Field 06B.
W69-06726

6F. Nonstructural Alternatives

KANSAS RIVER BASIN FLOOD CONTROL,
For primary bibliographic entry see Field 06B.
W69-06729

07. RESOURCES DATA

7A. Network Design

A HEURISTIC AID FOR THE DESIGN OF SEWER NETWORKS,
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 05E.
W69-06498

AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
American Society of Civil Engineers, Cambridge, Mass. Urban Hydrology Research Council.
For primary bibliographic entry see Field 04C.
W69-06770

WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1966-SEPTEMBER 1967,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02H.
W69-06786

7B. Data Acquisition

A DESIGN METHOD FOR DEEP WELL DEWATERING INSTALLATIONS,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02F.
W69-06430

APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
Cornell Univ., Ithaca, N. Y. Dept. of Botany.
Hugh F. Mulligan, and John M. Kingsbury.
Limnol Oceanogr, Vol 13, No 3, pp 499-506, July 1968. 6 fig, 3 tab, 20 ref.

Descriptors: *Phytoplankton, *Ponds, *Eutrophication, Algae, Biomass, Chlorophyll, New York.
Identifiers: *Coulter counter, *Population dynamics, Cellular size, Chlorella vulgaris, Cornell University, Electronic particle counting, Eudorina elegans, Euglena gracilis, Forest centrifuge, Glenodinium pulvisculus, Haemocytometer counting, Ithaca (NY), Glenodinium quadridens, Oocystis pusilla, Oocystis solitaria, Pandorina morum, Pediastrum boryanum, Pleodorina californica, Scenedesmus bijuga, Schroederia judayi, Sedgwick-Rafter method, Sphaerocystis schroeteri.

Utilizing Coulter counter with orifice of 100-micron diameter, authors analyzed, from 10 small morphometrically identical ponds, phytoplanktonic populations by 10 size intervals (mean volume, in microns, by interval: 9.1, 23.8, 49.5, 89.3, 191, 396, 715, 1530, 3170, 5720). They compared determinations of biomass by Coulter counting (B) in milligrams/liter, with chlorophyll-a (C) in milligrams/cubic meter and dry weight (D) in milligrams/liter. For example, in a single pond for five dates, ratio B:C had values 0.215, 0.270, 0.94, 0.302, 0.66; and B:D, 1.77, 1.76, 2.32, 1.82, 1.81. While counter cannot distinguish living from dead particles, nor species from species, its use in sizing and counting planktonic populations yields values of biomass with time which constitute highly resolved and characteristic profile of pond dynamics. Peak biomasses can often be correlated with a dominant phytoplankter, observable by direct microscopic examination. Biomass determined in this way is more precise than determinations of chlorophyll or dry weights, and method is more efficient than estimations utilizing haemocytometer. Authors emphasize that method is particularly effective when used in conjunction with standard methods. (Eichhorn-Wis)
W69-06540

GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
University Coll., London (England).
R. W. R. Rutland.
Photogramm Eng, Vol 35, No 2, pp 178-184, Feb 1969. 7 p, 5 fig, 7 ref.

Descriptors: *Aerial photography, *Photogrammetry, Photographs, *Dips, Stereoscopes, Stereoscopic photography, Surveying, *Mapping, Engineering geology, Reconnaissance surveys, *Slopes, Beds (Geology), Geological surveys, Geologic formations, Geologic investigations, *Geologic mapping, Graphical analysis.
Identifiers: Aerial reconnaissance, Photographic analysis, Plotting, *Photointerpretation, Slope angles, Strikes (Geology), Great Britain.

A stereographic method is presented for determining slope, strike, and dip from aerial photographs. A Wulff net is the only specialized equipment needed. The method can be used when a stereometer and mirror stereoscope are not available, and can be applied to more limited data than other methods. Strike and dip determination requires only that 2 outcrop lines of the bedding be observed; these lines do not need to be from the same level or from the same bedding plane. Slope determination is simpler and requires the attitude of only one line. No corrections for relief displacement or vertical exaggeration are necessary. The method can also be applied to oblique photographs. (USBR)
W69-06681

SOILS STUDIES USING COLOR PHOTOS,
McGill Univ., Montreal (Quebec).
J. T. Parry, W. R. Cowan, and J. A. Heginbottom.
Photogramm Eng, Vol 35, No 1, pp 44-56, Jan 1969. 12 p, 15 fig, 1 tab, 24 ref.

Descriptors: *Aerial photography, Photography, Photographs, *Soils, *Photogrammetry, Soil classifications, *Soil surveys, Gradation, Soil groups, Soil types, Soil texture, *Color, Soil physical properties, Bibliographies.
Identifiers: *Color photography, *Photointerpretation, Quebec (Canada).

Air photo interpretation and field survey in the Lac Bevin basin, Quebec, of exposures of bare soils varying in texture from clay to sandy loam, demonstrated the superiority of color photography over panchromatic in identifying and plotting soil boundaries, differentiating soil types within a series, and distinguishing variations of moisture and organic content. Exact correspondence between field and photo colors (as defined in the Munsell system) was not obtained. Very few soils provided a unique color signature at either the soil series level (U S Department of Agriculture) or the Unified Soil Classification System group level. A greater degree of differentiation between soil types was possible with color photos than with the panchromatic because the color image provided more varied stimuli to the interpreter. (USBR)
W69-06696

COMPUTER-AIRPLANE COMBO SAVES QUARTER MILLION DOLLARS ON SURVEYS AND ADMINISTRATION OF CONSTRUCTION CONTRACTS,
Bureau of Reclamation, Boise, Idaho.
Ervin E. Miller.
Pap, Bur Reclam, Reg 1, Boise, Idaho, 1969. 26 p, 8 fig, 8 ref.

Descriptors: *Photogrammetry, Photographic equipment, Computer systems, Components, Topographic surveys, Topographic mapping, Computer programs, Construction, Construction costs, Contract administration, Grand Coulee Dam, Powerplants, Cross-sections, *Aerial photography, *Surveying, Costs, Surveying instruments, Earthworks.
Identifiers: Construction practices, Computer capability, Grand Coulee Powerplant (Wash), Color photography, *Construction control.

Photogrammetric surveys, including topographic mapping and digitized cross-section data, are being used successfully on construction of the Grand Coulee Dam Third Powerplant. Topographic maps having scale ratio and contour intervals ranging from 1:240 to 1:4800 and from 2 to 10 ft, respectively, are used for general layout and detail design purposes. Digitized cross-section data, obtained at 10- and 20-ft intervals, are provided on standard IBM 80-column punch cards for preparing maps by automatic cartographic processes. Computer program linkage with digitized data and construction specifications is providing earthwork volumes and monthly construction summaries for payment purposes. Savings by the Government in time and man-days by adopting photogrammetric survey methods and automated procedures in administering construction contracts equal approximately $250,000, with good acceptance of the methods from general contractors. (USBR)
W69-06697

MEASUREMENT OF ROTATING MACHINERY VIBRATION AND FACTORS AFFECTING INSTRUMENT ACCURACY,
Carrier Corp., Syracuse, N. Y.
D. E. Neill.
Pap 68 WA/FE 19, Amer Soc Mech Eng Winter Annu Meet Energy Syst Exposition, New York, N. Y., Dec 1968. 9 p, 13 fig.

Descriptors: *Transducers, *Instrumentation, *Vibrations, Electronics, Monitoring, Shafts (Machinery), Errors, *Electronic equipment, *Sensors, Velocity, Detection, Frequency, Sensitivity, Conductivity, Calibrations, Magnetic fields, Mechanical engineering, Warning systems.
Identifiers: Eddy currents, *Rotating machines, Accuracy, Magnetic links.

Vibration monitoring systems can be a valuable tool for detecting incipient trouble or impending failure in rotating machinery. Some ascertainable defects are caused by unbalance, misalignment, bent shafts, and defective bearings. These monitoring systems, in addition to detecting trouble, often can automatically sound an alarm or shut the machine down if vibration exceeds a predetermined level. If a monitoring system is to be valuable and economical, the system must suit the particular application and must perform with reasonable accuracy. Error sources that can be introduced into systems measuring rotating machinery vibration are examined, and a typical system is described. Various contacting and noncontacting transducers are described and their error sources defined; inaccuracies introduced within the cable linking the transducer and monitor are outlined; and error sources within the monitor are discussed. (USBR)
W69-06702

USE OF TRACER TECHNIQUE IN SOIL EROSION RESEARCH,
Agricultural Research Service, Oxford, Miss.
For primary bibliographic entry see Field 04D.
W69-06704

TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH-VOLTAGE INSULATORS.
Brown Boveri and Co. Ltd., Baden (Switzerland).
For primary bibliographic entry see Field 08C.
W69-06708

POTENTIAL OF RADAR REMOTE SENSORS AS TOOLS IN RECONNAISSANCE GEOMORPHIC, VEGETATION AND SOIL MAPPING,
Kansas Univ., Lawrence.
David S. Simonett.
9th Int Congr Soil Sci, Trans, Vol 4, Adelaide, Australia, pp 271-280, 1968. 10 p, 5 fig, 21 ref.

Descriptors: *Radar, *Remote sensing, Sensors, Reconnaissance surveys, Geomorphology, *Mapping, Aerial photography, Soil classifications, *Vegetation, Agriculture, Crops, Bibliographies.

Identifiers: Radar equipment, *Soil maps.

Aerial photographs have been used extensively to aid ground studies for reconnaissance mapping of vegetation, soils, and geomorphic surfaces in remote, difficult-of-access, and underdeveloped areas in tropical and arctic latitudes. Studies using nonphotographic remote sensors (particularly infrared and radar) show that these systems, used in concert with photography, may add materially to information available and improve the efficiency of ground reconnaissance. Attention is focused on side-looking radar as a tool for such reconnaissance. Since radar imagery may be obtained in swaths up to 40 mi wide and is largely independent of the weather, its usefulness for reconnaissance mapping needs careful evaluation. A review is given of recent radar studies on: (1) the mapping of lineaments and lithologic units and use as a surrogate for 1:24,000 scale maps in hydrologic analysis; (2) the mapping of vegetation types, especially in relation to structure; and (3) its successes and shortcomings as an adjunct to photographs in soil reconnaissance surveys. (USBR)
W69-06718

NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
Washington Univ., Seattle. Lab. of Radiation Ecology.
For primary bibliographic entry see Field 05A.
W69-06766

TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
Research Inst. for Water Resources Development, Budapest (Hungary).
I. Sarvary.
Bull Int Ass Sci Hydrol, Vol 14, No 1, pp 121-127, Mar 1969. 7 p, 4 fig, 2 ref.

Descriptors: *Groundwater movement, *Karst, *Tracers, *Dye releases, Fluorometry, Tracking techniques, Subsurface drainage, Mine drainage, Drainage, Discharge (Water).
Identifiers: *Hungary.

The control of karstic water presents continuous difficulties at the Dorog coal-mines in the northwestern part of Hungary. To determine the rate of recharge and flow velocity within a few hundred metres of the mine workings, fluorescein used as tracer material was introduced through a borehole into the waterbearing formation. Samples were retrieved from water which entered the mine at several points. The tracer material was observed first 49 days after introduction, at a point situated 426 m distant from the borehole. Calculations of flow velocity were based on the geometry pattern of a single point sink. Basic criteria were the velocity computed on the basis of straight-line flow and constant discharge. From these data the dimensions of zones could be determined where the velocity or flow was higher than the average value. Information was obtained on the time or residence of dyed water in the high velocity zones, and thence on the areal flow velocity of karstic water. (Knapp-USGS)
W69-06774

PRELIMINARY REMOTE SENSING OF THE DELAWARE ESTUARY,
Geological Survey, Philadelphia, Pa.
For primary bibliographic entry see Field 02L.
W69-06793

A SYSTEM FOR MAKING REMOTE AND UNDISTURBED MEASUREMENTS OF SNOW SETTLEMENT AND TEMPERATURES,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02C.
W69-06803

A UNIVERSAL SURFACE PRECIPITATION GAGE,
Agricultural Research Service, Boise, Idaho. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02B.
W69-06804

GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
B. R. Payne, E. Halevy, E. Eriksson, J. Martinec, and A. I. Danilin.
Int At Energy Agency Tech Rep Ser 91, 1968. 214 p, 85 fig, 12 tab, 288 ref.

Descriptors: *Radioactivity techniques, *Radioisotopes, *Stable isotopes, Instrumentation, Nuclear meters, Nuclear moisture meters, Equipment, Radioactivity, Soil density, Soil density probes, Soil moisture meters, Tracers, Radioactive dating, Radioactive well logging, Tracking techniques, Meteorology, Hydrology, Groundwater movement, Soil water movement.
Identifiers: *Nuclear techniques (Hydrology).

General information is provided on the principles and applications of the nuclear and isotopic methods used in hydrological research. The Guidebook is not detailed enough for the unaided hydrologist in applications of particular techniques, but is intended to enable hydrologists to select the proper techniques for solving particular hydrologic problems with the help of nuclear scientists. Nuclear techniques for studies of the atmosphere, surface water, soil water, groundwater, and interrelations such as water balance, surface-groundwater relations, etc, are discussed. (Knapp-USGS)
W69-06811

RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
National Severe Storms Lab., Norman, Okla.
For primary bibliographic entry see Field 02B.
W69-06812

7C. Evaluation, Processing and Publication

RESPONSE OF BUBBLE-GAGE SERVOMANOMETERS TO OSCILLATIONS IN WATER LEVEL,
Geological Survey, Menlo Park, Calif.
J. R. Beck, and C. R. Goodwin.
Geol Surv open-file rep, 1969. 49 p, 10 fig, 5 tab.

Descriptors: *Stream gages, *Calibrations, Manometers, Water levels, Gaging stations, Lakes, Streams.
Identifiers: Bubble gages, Bubble-gage servomanometers.

Tests were conducted to evaluate the performance of bubble-gage servomanometers operating where the water level is oscillating at amplitudes and frequencies likely to be found at medium or high states in bodies of water subject to wind action. The dominant factors controlling the magnitude of registration errors at a given installation are the size and frequencies of the waves and the purge rate of gas flowing into the system. Other factors, are the depth of water over the orifice, the internal gas-filled volume of the manometer, and the volume of tubing used to connect with the orifice. The magnitude of underregistration may be reduced by increasing the purge rate, but the laboratory tests reported herein still show significant errors at a purge rate of 160 bubbles per minute. Gas-purged servomanometer systems tend to indicate a stage value less than the mean of the surge when surface waves are present. In some instances these errors are negligible or may be compensated for by the manner in which the record is used. A technique is given to predict the magnitude of errors but unless the wave characteristics are actually known, minor errors must be expected. A knowledge of this system characteristic should improve the quality of interpretation of stage records obtained by use of a bubble gage and permit corrective steps to be taken in instances where real problems exist. (Knapp-USGS)
W69-06434

USE OF DIGITAL COMPUTERS IN DISTRIBUTION SYSTEM ANALYSES,
Horner and Shifrin, Inc., Cons. Engrs., St. Louis, Mo.
William O. Shirley, and John J. Bailey.
J Amer Water Works Ass, Vol 58, No 12, pp 1575-1584, Dec 1966. 10 p, 3 fig, 4 ref.

Descriptors: *Digital computers, *Networks, *Water distribution (Applied), Hydraulic design, Hydraulic gradient, Analytical techniques, Compter programs.
Identifiers: St. Louis (Missouri).

The results of three digital computer studies were reported in which solutions were found for the hydraulic flow conditions in three municipal water systems in the St. Louis, Missouri area. The programs used the Hardy Cross method with the Hazen-Williams flow formula. The first study used a standard program available at the Washington University computer center. The program was modified for the other two studies to provide for reduced calculations and increased readability of output, and to allow for more rapid convergence to the solution by use of an overrelaxation technique and a control loop method. A computer check assured the proper number of loops in the input. It was concluded that the digital computer was an efficient tool for the solution of hydraulic network analysis problems, and that setting initial flows by computer required more iterations, but cost less than using engineering judgement computations for initial flows. (Gysi-Cornell)
W69-06503

A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
Research Council of Alberta, Edmonton.
William R. Turner.
Ground Water, Vol 5, No 4, 1967, pp 30-37. 7 p, 5 fig, 4 ref.

Descriptors: *Information retrieval, *Data storage and retrieval, *Hydrologic data, *Groundwater, *Computers, Data processing, Data collections, Wells, Logging (Recording), Scheduling, Water quality, Hydrogeology, Geology, Data transmission.
Identifiers: *Hydrodat system, Canada.

The ever-increasing volume of information being collected by the Groundwater Division of the Research Council of Alberta required that a storage and retrieval system be devised. The HYDRODAT computer-oriented system developed is a modification of the format developed by the U.S. Geological Survey. Basic elements of the system are: a well-schedule form for recording and coding of geologic, hydrologic, and water quality data (illustrated); and five 80-column IBM punch cards for transferring coded data to magnetic tape. Selective and rapid retrieval of large columns of ground-water information provides the geologist and engineer with analytical methods which would otherwise be tedious, if not impossible, to supply. (Affleck-Ariz)
W69-06764

STREAMFLOW RECORD LENGTH FOR MODELLING CATCHMENT DYNAMICS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W69-06781

HEC-2, WATER SURFACE PROFILES.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.

W69-06787

HEC-3, RESERVIOR SYSTEM ANALYSIS.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W69-06788

EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W69-06789

ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
California Univ., Los Angeles. Dept. of Engineering.
For primary bibliographic entry see Field 02F.
W69-06813

QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
California Univ., Los Angeles. Dept. of Engineering; and Nevada Univ., Reno. Dept. of Water Resources.
For primary bibliographic entry see Field 02A.
W69-06822

08. ENGINEERING WORKS

8A. Structures

THE POSSIBILITY OF USING A MOVABLE DAM: THE 'FABRIDAM' AND ITS APPLICATION IN ARID REGIONS,
Plan Organization (Iran). Water Planning Group.
For primary bibliographic entry see Field 04A.
W69-06455

A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
Central Water and Power Commission (India).
For primary bibliographic entry see Field 04A.
W69-06461

BURNQUIST V FISCHER (FLOWAGE EASEMENT APPURTENANT TO DAM).
For primary bibliographic entry see Field 06E.
W69-06615

DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 05G.
W69-06675

INNOVATIONS AND THE FUTURE OF CATHODIC PROTECTION,
Marshall E. Parker.
Mater Prot, Vol 8, No 2, pp 21-25, Feb 1969. 5 p, 20 ref.

Descriptors: *Cathodic protection, Corrosion, *Corrosion control, Direct current, Rectifiers, Electric potential, Digital computers, Anodes, Telemetry systems, Pipelines, Operation and maintenance, Bibliographies.
Identifiers: *Underground corrosion, Stray current corrosion, Ground currents, *Power supplies, Deep-well electrodes.

Although very few new advances have been made in the principles of cathodic protection, the application technology has changed during the past few years. One topic of great interest in cathodic protection is the prevention of corrosion to underground metallic structures caused by high-voltage direct-current transmission lines. Problems involved in designing corrosion control systems for stray currents and currents discharged from hvdc lines are described. The selection of selenium versus silicon rectifiers is discussed and the application of constant current and automatic control rectifiers is covered. Developments are discussed in monitoring and surveying pipe-to-soil potentials, computer applications for design and operation, using deep-well anodes, and direct-current power sources. Direct-current power sources include fuel cells, thermoelectric generators, atomic cells, solar cells, and the rectifier. (USBR)
W69-06677

PRESSURE TRANSIENTS IN HYDRAULIC PIPELINES,
City Univ., London (England).
A. R. D. Thorley.
Pap No 68-WA/FE-2, Amer Soc Mech Eng Winter Annu Meet Energy Syst Exposition, New York, N. Y., Dec 1968. 8 p, 8 fig, 2 tab, 13 ref, append.

Descriptors: *Hydraulic transients, *Pipelines, *Transients, Pipes, Boundary values, Hydraulics, Tubes, Fluid flow, *Water hammer, Head loss, Equations, Transducers, Waves (Water).
Identifiers: Boundary conditions, *Pressure waves.

Equations of fluid motion in a pipe are developed from a consideration of the forces and moments in the pipe wall. The equations are solved for boundary conditions representing the situation where the fluid is flowing steadily through a horizontal pipe and a valve at the downstream end is closed instantaneously. The solution gives theoretical results for the usual water-hammer wave and predicts the existence of a precursor wave. Expressions are derived for the velocities of propagation of both transients and their associated pressure changes. A comprehensive series of experiments was performed. Some interesting and probably unique results were obtained, demonstrating the behavior of both transients. Velocity and pressure change measurements were made. The effect of axial restraint on the pipe was demonstrated. (USBR)
W69-06700

8B. Hydraulics

PIPELINE PLANNING BY DYNAMIC COMPUTER PROGRAMMING,
Tahal Construction Engineers Ltd., Tel Aviv (Israel).
For primary bibliographic entry see Field 06A.
W69-06493

USE OF DIGITAL COMPUTERS IN DISTRIBUTION SYSTEM ANALYSES,
Horner and Shifrin, Inc., Cons. Engrs., St. Louis, Mo.
For primary bibliographic entry see Field 07C.
W69-06503

A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
Ain Shams Univ., Cairo (Egypt). Dept. of Soils.
For primary bibliographic entry see Field 02F.
W69-06517

COMPUTATION OF PRESSURES AND VELOCITIES IN THE CURVILINEAR ZONE OF PRESSURE SPILLWAYS, FOR PREDICTING CAVITATION,
S. M. Slisskii, and A. E. El-Ansari.
Hydrotech Constr, No 5, pp 426-430, May 1968. 5 p, 4 fig, 3 tab, 5 ref.

Descriptors: *Pressure conduits, Pressure distribution, *Spillways, Pressure tunnels, Outlets, *Cavitation, Conduits, Model tests, Head loss, Hydraulic models, Hydraulic conduits, Hydraulics, Roughness, Foreign research, Laboratory tests, Linings.
Identifiers: Pressure shafts, Outlet tunnels, Bernoulli theorem, USSR, Curvature.

The conduit portion of pressure spillways conveying high-velocity flows should be profiled to preclude cavitation. Considering this criterion in design for a hydroelectric station, the permissible conduit-ceiling curvature was determined by hydraulic laboratory investigations conducted on several alternative spillway models. Theoretical and experimental pressure values at the ceiling of a particular section with various radii are compared. Computing pressures along the curved zone of a pressure spillway, specifically at the ceiling, requires: (1) determining the piezometric head corresponding to the mean velocity computed by applying Bernoulli's equation, (2) computing the kinetic pressure on the boundary of greatest curvature, and (3) determining the piezometric head corresponding to the velocity and pressure at the ceiling of the section. Predetermining pressures by computation leads to a reduction in the number of alternatives requiring investigation and permits detection of inaccuracies introduced during the experiment setup. Investigation of the lining requirements for the spillway is discussed. (USBR)
W69-06713

GEOLOGY, DESIGN, AND CONSTRUCTION OF DEEP WELLS IN SEDIMENTARY FOUNDATIONS,
For primary bibliographic entry see Field 02F.
W69-06759

8C. Hydraulic Machinery

NANTAHALA POWER AND LIGHT CO V SLOAN (FLOWAGE EASEMENTS).
For primary bibliographic entry see Field 06E.
W69-06620

ELECTRICAL FEATURES OF THE GRAND COULEE THIRD POWER PLANT,
Bureau of Reclamation, Denver, Colo.
John V. Baptist, and Roy Y. Nitta.
Inst Elec Electron Eng Spectrum, Vol 6, No 1, pp 89-95, Jan 1969. 7 p, 5 fig, 3 tab.

Descriptors: *Hydroelectric plants, *Electric power production, Extra high voltage, Control systems, Electric powerplants, Hydraulic turbines, Electric generators, *Switchyards (Electrical), Specifications, Handling equipment, Installation, Electric cables, Construction, Scheduling, Bus (Electrical), Contracts, Washington.
Identifiers: *Grand Coulee Powerplant (Wash), *Power cables, Cable terminations.

Addition of the Grand Coulee Third Powerplant, having an installed nameplate capacity of 7200 mw, will increase the 1974 nameplate capacity of the Grand Coulee power complex to 9374 mw. The Third Powerplant will have twelve 600-mw hydroelectric generating units, the largest units in the world; 525-kv insulated power cables from transformer high-voltage bushings to overhead powerlines, the first installation in the world of such high-voltage power cables; and an 1800-tonne (metric ton)-capacity hydraulic-hoist-type gantry crane. The status of electrical designs for the proposed 7200-mw powerplant is described. The modification of existing switchyards and construction of a new 500-kv switchyard are discussed. The large dimensions and great weights of such large turbines and generators impose complex problems in transportation and handling. Some methods of overcoming these problems are presented. The control system for the powerplant and switchyard, including functions, is reviewed. (USBR)
W69-06684

SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
Cleveland Electric Illuminating Co., Ohio; and Westinghouse Electric Corp., Pittsburgh, Pa.

For primary bibliographic entry see Field 06A.
W69-06685

500-KV AC SUBSTATION DESIGN CRITERIA--SUMMARY OF INDUSTRY PRACTICES,
Paul R. Dolan, L. M. Berry, and R. R. Blanchard.
Pap 69 TP 45-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1969. 12 p, 4 tab, 20 ref.

Descriptors: *Extra high voltage, *Substations (Electrical), Electric relays, *Design criteria, Clearances, Electrical design, Electrical insulators, Bus (Electrical), Circuit breakers, Power transformers, Environmental effects, Electrical equipment, Foreign design practices, Lightning arresters, Bibliographies.
Identifiers: Design improvements, Switching surges, Canada, Protection (Electrical), *Design analysis, Electric conductors, *Electric utilities.

To determine major trends in 500-kv substation design practices, a survey was made of 10 major electric utility systems in the United States and Canada. Results are presented in tabular form for easy comparison of design features. Major variations in data are identified and explained. These data are invaluable to those having 500-kv systems under study, and will serve as a permanent record of the state of the art at this point. These data represent latest design criteria of the participating agencies, but all stations constructed by these companies do not conform to the exact criteria because individual circumstances usually require design changes or modifications. Some companies used more than one design and changed criteria with experience or to meet special conditions. Although these data reflect individual design philosophies of the 10 agencies involved, they do not show the alternatives considered or give the reasoning behind these decisions. Prospective designers are cautioned against using this information verbatim and out of context with the total design setting from which it is taken. (USBR)
W69-06686

A SWING RELAY FOR THE EAST-WEST INTERTIE,
Bureau of Reclamation, Denver, Colo.
F. R. Schleif, L. W. Lloyd, and R. W. World.
Pap 69 TP 60-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1969. 6 p, 10 fig, 1 ref.

Descriptors: *Electric relays, *Electric power, Characteristics, Field tests, Power system operations, *Transmission (Electrical), Oscillation, Electric power production, Electric power demand, Electric power failure, Electronic equipment, Analog computers.
Identifiers: *Interties, *Interconnected systems, Interchanges, Power system stability, Separation.

Closing the ties to interconnect power systems across the continent causes new relaying problems. A special relay developed as a solution to these problems has been monitoring the East-West Intertie since reestablishment of this system on Dec 3, 1967. The relay is designed to sense conditions of the intertie and to anticipate when interchange is approaching difficulty. Power, rate-of-change of power, and oscillation quantities are sensed. The relay, installed at Yellowtail Powerplant, Mont, also effects transfer tripping at Fort Peck, Mont, and Stegall, Nebr, for prompt and clean East-West separations and minimum disturbance to the system. The basic principles, design and construction, coordination characteristics, and operating experience of the relay are discussed. (USBR)
W69-06687

OPEN BREAKER PROTECTION OF EHV SYSTEMS,
Westinghouse Electric Corp., East Pittsburgh, Pa.; and Monongahela Power Co., Fairmont, W. Va.
Andrew R. Hileman, Charles L. Wagner, and Richard B. Kisner, Jr.
Pap 69 TP 84-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1969. 15 p, 4 fig, 5 tab, 6 ref.

Descriptors: *Extra high voltage, *Circuit breakers, Laboratory tests, Electrical equipment, Lightning arresters, Resistors, Test procedures, Impulse tests (Electrical), Electric arcs, Electric insulation.
Identifiers: *Lightning protection, *Switching surges, Test results, *Spark gaps, Selection, Lightning surges, Recommendations, Flashover.

Lightning arresters on the line side of every circuit breaker provide absolute protection for an open breaker condition but at a high cost. No line-entrance protection presents some risk of breaker damage. Line-entrance rod-gaps offer a compromise between these extremes. The probabilities of failure using these 3 alternatives are discussed, and a procedure whereby the spacing of the line-entrance gap can be determined is described. Since this procedure depends on the particular configuration of the gap being used, test data are presented for one particular configuration used on a 345-kv system. Based on these data, recommended gap spacings for 345- and 500-kv systems are developed. Results of lightning impulse and switching surge tests are summarized. (USBR)
W69-06688

SHUNT CAPACITOR ENERGIZATION WITH VACUUM INTERRUPTERS--A POSSIBLE SOURCE OF OVERVOLTAGE,
I-T-E Imperial Corp., Philadelphia, Pa.; and City of Los Angeles, Calif.
E. W. Boehne, and S. S. Low.
Pap 69 TP 83-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1969. 20 p, 18 fig, 14 ref, 2 append.

Descriptors: *Capacitors, *Interrupters, Failure (Power), Analysis, Electrical studies, Frequency, Electric power, Field tests, Damages, Transients, Switching circuits, Electric potential, Power transformers, Disturbances, Analog computers, Differential equations, Electrical impedance.
Identifiers: *Interrupter switches, *Overvoltage, *Switching, Test results, Protection (Electrical).

Energization of a large capacitor bank with vacuum interrupters coupled with simultaneous failure of a load transformer on a radial feeder prompted this study. The study reveals a source of overvoltage accompanied by sudden and severe voltage reversals at the transformer terminals. This phenomenon is characterized by the momentary interruption and subsequent reignition of the 2 predominant transient high natural-frequency oscillatory capacitor closing currents. Momentary interruptions occur at numerous higher natural-frequency current zeros during the short interval between the prestrike of the arc and metal-to-metal closure of the contacts, and at the first lower natural-frequency current zero either during the short interval between the prestrike of the arc and the closing of the metallic contacts, or during contact separation caused by mechanical contact bounce, or both. Field tests and computer analyses were studied. Computer studies duplicate field test results and permit evaluating various combinations of overhead and underground circuit parameters and corrective measures. (USBR)
W69-06689

CALCULATION OF BALANCED AND UNBALANCED FAULT CURRENTS IN AC-DC POWER SYSTEMS,
Wisconsin Univ., Madison.
A. G. Phadke.
Pap 69 TP 117-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1969. 7 p, 4 fig, 1 tab, 7 ref, 2 append.

Descriptors: *Faults (Electrical), *Electrical networks, Sequence, *Alternating current, *Direct current, Transmission (Electrical), Bus (Electrical), Calculations, Digital computers, Computer programs, Converters (Electrical), Electrical studies, Control systems, Electric power, Electric currents, Electric converters.
Identifiers: Accuracy, Impedance, Harmonics, Electric converter stations.

As high-power direct-current transmission lines become integrated in a-c networks, analytical tools for calculating the performance of composite ac-dc networks under various normal and abnormal operating conditions must be developed. A method is presented for calculating fault currents in composite ac-dc networks for balanced and unbalanced faults on the a-c portion of the network. As in the case of a-c network fault studies, only steady-state 60-cycle quantities are assumed to exist on the a-c network; the current in the d-c line is assumed to be without an a-c component. The calculation procedure is suitable for programming on a digital computer; a numerical sample is included. Limitations of the method are contained in the assumptions noted and in the approximations used to represent the converter impedance functions. The present method should not be considered an exact solution procedure for the unbalanced fault study, but a somewhat better approximation to a complicated problem. (USBR)
W69-06690

COMPUTER-AIRPLANE COMBO SAVES QUARTER MILLION DOLLARS ON SURVEYS AND ADMINISTRATION OF CONSTRUCTION CONTRACTS,
Bureau of Reclamation, Boise, Idaho.
For primary bibliographic entry see Field 07B.
W69-06697

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
A. U. Bugov, V. A. Kovalenko, and A. S. Belinskii.
Transl from Energomashinostr, No 3, pp 24-26, 1963. Bur Reclam Transl 803, Feb 1969. 10 p, 3 fig, 2 tab, 2 ref.

Descriptors: *Vibrations, Oscillation, *Hydraulic turbines, Damping, Electric generators, *Francis turbines, Rotation, Field tests, Design, Dynamics, Hydraulic machinery, Shafts (Machinery), Supports, Resonance, Foreign research, Natural frequency, Turbine runners, Prototype tests, Theoretical analysis.
Identifiers: *Torsional vibrations, *Gyroscopic effects, *Harmonics, Baksansk Powerplant (USSR), Critical velocity, Leningrad Metalworks (USSR).

When designing a large hydroelectric unit, certain problems must be resolved relating to the vibrational strength of rotating parts subjected to the effect of disturbing forces of mechanical and hydrodynamic origin. Information on disturbing forces that act upon a rotor is limited, but the fact is known that a rotor is constantly subjected to action of disturbing forces with torsional frequency, and a frequency equal to the product of the torsional frequency multiplied by the number of turbine blades. Rotors are designed for natural vibration frequencies that should not be equal to, or a multiple of, the frequencies of the disturbing forces. During design, the values of the natural vibration of a rotor must be determined quite closely. Results are given of experimental investigations and theoretical analyses made by Leningrad Metalworks (LMZ) on full-scale models at the Baksansk Powerplant. Good agreement was shown between theoretical and field test data of such vibrational characteristics of a rotor as natural vibration frequencies, damping properties of the design, and the effect of yield and number of supports and additional masses of water and mass of the runner on natural vibration frequencies in the unit rotor. (USBR)
W69-06698

SOME ASPECTS OF INSULATION CO-ORDINATION IN HVDC SYSTEMS,
Brown, Boveri and Co. Ltd., Baden (Switzerland).
E. Sarbach.
Brown Boveri Rev, Vol 55, No 7, pp 344-351, July 1968. 8 p, 6 fig, 1 tab, 3 ref, append.

Descriptors: Extra high voltage, *Direct current, Foreign research, *Electric insulation, *Lightning arresters, Lightning, Transmission lines, Stress, Economics, Electric potential, Electric currents, Electric converters, Rectifiers, Transmission (Electrical), Electrical design.
Identifiers: *Protection (Electrical), *Thyristors, *High voltage, Overvoltage, Switzerland, Outages.

Keeping the protection level as low as possible in hvdc transmission systems using thyristors as rectifier devices is economically essential. This requirement can be accomplished by using lightning arresters, but selecting the appropriate rated arrester voltage can be a problem. Various factors involved in properly selecting arrester voltage ratings for hvdc systems are discussed. Thyristors are very sensitive to rapid voltage changes. A discussion is given of the stresses that thyristors are subjected to by high rates of rise of atmospheric overvoltages that can enter a station from overhead lines. (USBR)
W69-06707

TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH-VOLTAGE INSULATORS.
Brown Boveri and Co. Ltd., Baden (Switzerland).
T. Weinmann.
Brown Boveri Rev, Vol 55, No 7, pp 351-358, July 1968. 8 p, 10 fig, 1 tab, 4 ref.

Descriptors: *Electrical insulators, Electric insulation, Wetting, Conductivity, *Test procedures, *Contamination, Test facilities, Fog, Atmospheric pollution, Electric potential, Electrical equipment, Wet condition, Transmission (Electrical), Electrical conductance, Laboratory tests, Foreign research.
Identifiers: *Test results, *Flashover, *Salt spray tests, Leakage current, Electrical insulation tests, Testing equipment, Switzerland.

Results of many years experience in high-voltage testing of artificially contaminated insulators in the Brown Boveri laboratory are discussed. Methods used for artificially contaminating insulators to simulate field conditions are described. These methods provide a simple and reliable means for comparing insulators of different shapes but having the same voltage rating. A salt-fog method for simulating coastal conditions and an infusorial earth coating for simulating industrial pollution have caused no difficulties during tests. Some more important factors influencing artificial-pollution testing of insulators are considered and test results given. A fundamental reason for artificial-pollution testing is to determine relative values and to reach absolute conclusions regarding the extent of natural contamination that will cause a breakdown. (USBR)
W69-06708

BROWN BOVERI DISTANCE PROTECTION SYSTEMS EMPLOYING CARRIER TRANSFER,
Brown, Boveri and Co. Ltd., Baden (Switzerland).
J. Gantner.
Brown Boveri Rev, Vol 55, No 7, pp 365-371, July 1968. 7 p, 8 fig, 10 ref.

Descriptors: *Electric relays, Distance, *Transmission lines, Faults (Electrical), Powerline carriers, Circuits, Resistance, *Reliability, *Selectivity, Electrical currents, Reactance, Inductance, Coordination, Microwaves, Electrical equipment, Electric potential, Foreign research.
Identifiers: *Protection (Electrical), *Protective distance, Series capacitors, Short circuits, Switzerland.

To ensure that distance relays at both ends of a transmission line trip when a fault occurs, a method of transmitting signals between the ends of the line is essential. Various facilities are available for accomplishing this task. Several circuit arrangements used in conjunction with distance protection systems are described and their operations explained. When selecting the type of protective circuit to be used, these aspects must be considered: (1) reliability with which tripping is effected; (2) reliability with which undesired tripping caused by noise signals is avoided; (3) selectivity; and (4) tripping times. Special attention should be directed to those cases where operating a distance relay is difficult. These are: (1) earth faults in parallel lines (caused by the effect of mutual zero-sequence impedances); (2) very high resistances to earth; (3) very weak infeed at one end; and (4) transmission lines with 3 or more ends. (USBR)
W69-06709

DISTANCE PROTECTION OF HIGH-VOLTAGE LINES CONTAINING SERIES CAPACITORS,
Brown, Boveri and Co. Ltd., Baden (Switzerland).
C. V. Narayan.
Brown Boveri Rev, Vol 55, No 7, pp 372-382, July 1968. 11 p, 9 fig, 2 tab, 14 ref.

Descriptors: *Electric relays, *Transmission lines, Reactance, Faults (Electrical), Electric currents, Inductance, *Capacitors, Transmission (Electrical), Distance, Electric potential, Electrical equipment, Powerline carriers, Coordination, Foreign research.
Identifiers: *Protection (Electrical), *Protective distance, Spark gaps, *Series capacitors, Short circuits, Switzerland.

High-voltage transmission lines containing series capacitors impose special requirements regarding distance protection because the capacitors represent a negative reactance and because the reactance measured by the relay (before and after the protective spark-gap of the capacitor break down) may vary considerably. Fault currents and voltages along a 2-circuit line equipped with series capacitors, compensating up to about 80% of the line's inductive reactance, are analyzed. Functions of a protective system before and after the protective spark-gap breaks down because of line faults are described. A special arrangement of the distance protection system suitable for high-voltage lines having series capacitors is studied. The lines have a high-speed basic step and backup steps, and use a transmitted signal. Transmission lines having series capacitors at the beginning of the protected section can be protected selectively with distance relays. (USBR)
W69-06710

8D. Soil Mechanics

HIGH EARTHFILL DAM FOUNDATION GROUTING DESIGN AND CONSTRUCTION PROCEDURES,
Bureau of Reclamation, Denver, Colo.
Lloyd R. Gebhart.
Pap, Amer Soc Civ Eng Nat Meet Water Resour Eng, New Orleans, La, Feb 1969. 8 p.

Descriptors: *Earth dams, Dams, *Dam foundations, Dam construction, Dam failure, Dam design, Specifications, Grout curtains, Safety, Cracks, *Grouting, Foundation investigations, Cutoffs, Permeability, Geology, Drill holes, Geologic investigations.
Identifiers: Grouting pressure, Permeability tests, Blanket grouting, Grout mixes, Geologic defects.

Adequate exploratory investigations for determining rock structure, permeability, and other geological information are desirable to prepare a realistic grouting design and dependable quantities. Water tests of exploratory holes are the most commonly used indicators for estimating drilling and grouting quantities. Grouting specifications should remain flexible to allow the foundation treatment to be modified to fit the conditions as the foundation is uncovered and drilling and grouting get underway during construction. The general grout plan for the hypothetical dam provides for shallow low-pressure blanket grouting to fill voids in the cavernous limestone near the surface to protect the dam embankment and foundation contact. Two deep, high-pressure grout curtains will provide a cutoff and increase the percolation path under the dam. The circulating line and manifold of the grout equipment are vital to closely regulate grout pressures. The method of closures or split spacing determines when the grout program is adequate. Using a grout with an optimum water-cement ratio without slugging the hole is essential for repairing the foundation to fit requirements for a safe structure. (USBR)
W69-06674

HORIZONTAL MOVEMENTS RELATED TO SUBSIDENCE,
California, Univ., Los Angeles; and California Univ., Davis.
Kenneth L. Lee, and C. K. Shen.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 95, No SM1, pp 139-166, Jan 1969. 28 p, 18 fig, 45 ref, 2 append.

Descriptors: Earth dams, *Settlement, *Subsidence, *Consolidation, Shear stress, Mining, Groundwater mining, Compressibility, Poisson ratio, Test procedures, Model tests, Elastic deformation, Strain, Internal friction, Soil mechanics, Embankments, Stress, Bibliographies, Rock foundations.
Identifiers: Arching, Finite element method, Compressible soils, Soil modulus, *Horizontal movement, Compressible foundation.

A review of many documented field examples shows that horizontal surface movements often accompany vertical subsidence and that, although these movements may result from a wide variety of different situations, they all appear to follow a well-defined pattern. The pattern is the same for (1) horizontal movements associated with mining subsidence; (2) subsidence caused by gas, oil, or water pumping, or subsidence caused by deep consolidation under a heavy fill load such as at an industrial development or an earth dam. A semiempirical and simple equation is presented for predicting the nature and magnitude of horizontal movements correctly, provided the vertical subsidence profile is known. An application of the finite-element method of analysis in computing vertical and horizontal movement is illustrated. Results of the 2 methods are compared with data obtained from (1) a laboratory model, (2) a hypothetical earth dam on a compressible foundation, and (3) a rockfill dam that settled as the water level rose in the reservoir. (USBR)
W69-06692

PREDICTION OF SWELLING PRESSURE OF CLAYS,
Technion - Israel Inst. of Tech., Haifa (Israel); and Ministry of Housing (Israel).
Amos Komornik, and David David.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 95, No SM1, pp 209-225, Jan 1969. 17 p, 8 fig, 1 tab, 11 ref, 2 append.

Descriptors: Clay minerals, *Atterberg limits, Moisture content, *Clays, Density, Soil mechanics, *Soil physical properties, *Swelling, Dry density, Chemical properties, Soil structure, Foreign research, *Expansive clays, Preconsolidation.
Identifiers: *Swelling pressures, Swelling pressure tests, Surface area, Compression index.

Swelling pressure of naturally occurring clays is related to chemico-physical properties such as specific surface area or particle spacing represented by simple indicative parameters. Significant statistical correlation exists between swelling pressure and combined data comprising density, moisture content, and liquid limit. Swelling

pressure increases with an increase in the initial density and liquid limit and with a decrease in moisture content. Almost no correlation was found between swelling pressure and any of the above factors separately. Good correlation was found between the free swell and plasticity index, irrespective of chalk content. Almost no correlation was found between the shrinkage limit and plasticity index or free swell. An expression was derived relating compression index to liquid limit. Preloading of clays resulted in considerably higher swelling pressures. This result is caused by an increase in the number of particles oriented perpendicular to the external load and a density increase. (USBR)
W69-06693

CIRCULAR AND LOGARITHMIC SPIRAL SLIP SURFACES,
Manchester Univ. (England).
Eric Spencer.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 95, No SM1, pp 227-234, Jan 1969. 8 p, 4 fig, 1 tab, 9 ref, 2 append.

Descriptors: *Slope stability, *Stability, *Stability analysis, Shear resistance, *Embankments, Slipping, Safety factors, Foreign research, Soil mechanics, Earth dams, Shear strength, Internal friction, Cohesion, Effective stress, Slip-circle method.
Identifiers: *Slip surface, Failure surfaces.

A method of analyzing embankment stability is described that applies equally to slip surfaces having a cross section either in the form of a circular arc or a logarithmic spiral arc. The method applies to several stability problems arising because of wide variations in embankment slope and soil properties. Solutions to critical cases are obtained for both types of slip surfaces and values of the overall factor of safety, F, are compared. The circular arc gives the lower value for the factor of safety. The shape of the logarithmic spiral is not determined by the value of the angle of shearing resistance of the soil. The factor of safety against shearing on vertical planes, F sub v, was also investigated for each of the critical cases; in every case, values of F sub v exceeded the corresponding value of F. (USBR)
W69-06694

NON-ENGINEERING ELEMENTS IN FACTORS OF SAFETY IN SOIL AND FOUNDATION ENGINEERING,
Connecticut State Highway Dept., Wethersfield.
Philip Keene.
Pap, Annu Meet Highw Res Board, Jan 1969. 14 p, 10 ref.

Descriptors: *Safety factors, *Safety, Earth dams, *Earthworks, Costs, Foundations, Economics, Economic impact, Construction, Soil engineering, Political aspects, Psychological aspects, Social aspects, Failures, Soil mechanics, Design, Public relations, Failure (Mechanics), Foundation failure, Risks.

In earthwork and foundation engineering, technical elements that enter into producing an approximate factor of safety against failure are usually recognized, although not always understood. Other elements that should influence the choice of a factor of safety are economic, sociological, psychological, and political. The economic element is usually considered, but costs resulting from a failure may be difficult to estimate. Sociological and psychological elements overlap and may be grouped together. The most ethical in this group are the humanitarian elements-avoiding a failure that would cause personal injuries, deaths, and undue hardships. Less justifiable elements that increase costs and the safety factor are: aggrandizement of highly expensive projects, increase in fee for design and construction, lack of publicity for savings effected, and cost of project borne by the owner. Similar elements are fear of being blamed (fairly or unfairly) for defective design or construction, and the desire to design quickly to save expenses. The political element arises on public projects when fear that a failure or alleged poor construction could come to the attention of persons wishing to discredit the administration. (USBR)
W69-06695

SOIL AS AN ENGINEERING MATERIAL,
Bureau of Reclamation, Denver, Colo.
W. G. Holtz.
J Mater, Vol 4, No 4, pp 847-915, Dec 1968. 69 p, 52 fig, 4 tab, 80 ref.

Descriptors: *Soil engineering, *Soil mechanics, Soil properties, Soil formation, Pore pressure, Consolidation, Soil compression tests, Seismic investigations, Shear tests, Soil physical properties, Expansive soils, Soil density, Soil dynamics, Soil classifications, Bibliographies, Clay minerals, Settlement, Soil tests, Foundations, Earthquakes.
Identifiers: Construction control, American Society for Test and Mat, *Marburg Lecture.

The 42nd Edgar Marburg Lecture is a general discussion concerning soil as an engineering material, pointing out particular properties, the current state of knowledge, and needs for future developments. The forming processes of soils are many and varied. These processes produce natural deposits and formations that are seldom homogeneous, and soil components having a variety of characteristics. The job of the soils engineer is largely one of investigation to determine physical properties of the material and reactions of the soil mass to imposed conditions. Compared with other common building materials, soils are difficult to sample and test. To obtain meaningful data for designing earth structures and foundations, consideration must be given to geological history, present conditions, construction sequences, and anticipated operating conditions. Proper construction control procedures are important to assure that the properties assumed in the design are obtained. While advances have been made in theory, in determining meaningful parameters, and in understanding soil mass behavior, practitioners of the discipline still rely heavily on empirical procedures and judgment developed by training and experience. (USBR)
W69-06699

STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
Norwegian Geotechnical Inst., Oslo.
Johan Moum, Olva Ihlen Sopp, and Tor Loken.
Norw Geotech Inst, Publ 81, pp 1-7, 1968. 7 p, 3 fig, 6 tab, 9 ref.

Descriptors: *Quick clays, *Soil stabilization, *Salts, *Wells, Clays, Sodium chloride, *Chlorides, Soils, Aluminum compounds, Diffusion, Lime, Laboratory tests, Iron compounds, Calcium hydroxide, Foreign research, Undisturbed samples, Illite, *Soil mechanics, Soil engineering, Costs, Engineering geology, Potassium compounds.
Identifiers: Potassium chloride, Sulfuric acid, Norway, Undisturbed soils, Sweden.

Laboratory test results from Norway indicate that diffusion of salt through wells may be a practical solution to many soil stabilization problems. For quick clay of illitic-chloritic composition, potassium chloride has the best overall effect. The investigated quick clay is of a composition very common in Norway and some parts of Sweden, and the results are generally valid for clays of this type. In other types of clay, other chemicals may give better results. Probably in no case does stabilization by diffusion with slaked lime (calcium hydroxide) seem to be practical. The price of potassium chloride in Norway is between 0.30 and 0.50 krone ($0.042 and $0.07) per kg. About 5.5 kg of potassium (corresponding to 10.5 kg of potassium chloride) are required for the fastest stabilization of 1 cu m of soil of this type. A field project has been started to check these results. (USBR)
W69-06719

8E. Rock Mechanics and Geology

FOUNDATION PROBLEMS OF RUEDI DAM AND RESERVOIR,
Bureau of Reclamation, Denver, Colo.
Edward R. Lewandowski, and Alexander Zlaten.
Pap, Water Resour Eng Conf, Amer Soc Civ Eng, New Orleans, La, Feb 1969. 28 p, 9 fig, 4 ref.

Descriptors: *Earth dams, Dams, Dam design, *Dam foundations, Geology, Foundations, Reservoirs, Grouting, Excavation, Engineering geology, Rock bolts, Gypsum, Grout curtains, Spillways, Outlet works, *Rockfill dams, Foundation investigations, Geologic investigations, Reservoir leakage.
Identifiers: Ruedi Dam (Colo), Fryingpan-Arkansas Proj (Colo).

The presence of a large mass of gypsum in the area of Ruedi Dam and Reservoir necessitated detailed geologic investigations of the sites. The main concern at Ruedi was that the gypsum was a plug containing major cavities and channels or that the gypsum would dissolve; either situation would provide major escape routes for the reservoir water. Extensive explorations showed that Gyp Hill was formed by gypsum beds deforming under plastic flow under relatively low differential stresses. This process prevents large openings from developing by solution at great depths. The plasticity of the gypsum renders the mass essentially impervious to any large passage of water, especially downstream of Ruedi Dam where the load consists of over 4000 ft of rock. Design features incorporated in constructing the dam included: (1) selective excavation, (2) extensive grouting, and (3) rock bolting. The dam was completed in 1968, and impounded water to a depth of over 190 ft the first year. (USBR)
W69-06673

GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
University Coll., London (England).
For primary bibliographic entry see Field 07B.
W69-06681

WATER LAWS AND CONCEPTS,
Geological Survey, Washington, D. C.
Harold E. Thomas.
Eos, Trans Amer Geophys Union, Vol 50, No 2, pp 40-50, Feb 1969. 11 p, 30 ref.

Descriptors: *Water law, Legal aspects, Environment, Laws, Cultures, Consumptive use, Humid climates, Water shortage, *Water rights, Water utilization, History, Bibliographies.
Identifiers: Litigation.

Throughout human history various laws and customs have developed concerning rights to water resources. Many existing laws and concepts are influenced by the environment in which they originated and reflect the relative abundance or scarcity of water. Many concepts reflect users' initial interests in the water, and have been passed from generation to generation. Some laws and concepts have been transplanted through migrations and colonial expansions to different environments. In many places, water laws that had been well adapted to natural environment have become less tenable because of man's activities in modifying that environment, or because of increased water use. The water rights systems in the U S vary from state to state; some are reasonably fitted to their environment, some have outlived their place in history, some are wasteful, and some show favoritism to special interests or segments of the population. Water use rights are universally recognized as real property, with constitutional protection against deprivation without due process of law. Until recently the rights in common to water, applicable to each member of the mass population, have received far less attention than the individual rights

to use water, recognized as property rights. (USBR)
W69-06683

BRITTLE ROCK FAILURE UNDER TRIAXIAL STRESS,
Georgia Univ., Athens.
A. A. Giardini.
Pap 68-WA/PT-3, Amer Soc Mech Eng Winter Annu Meet Energy Syst Exposition, New York, N. Y., Dec 1968. 4 p, 4 fig, 7 ref.

Descriptors: *Rock mechanics, *Rock properties, Rocks, Stress-strain curves, Slipping, *Triaxial compression, *Triaxial shear, Triaxial stress, Shear strength, *Brittle failures, Compressive strength, Shear failures, Granites, Strength of materials, Materials testing, Cracks.
Identifiers: Triaxial load tests, Triaxial tests, Microcracks, Confining pressure, Coulomb failure theory.

Granitic rock specimens were tested to failure by triaxial testing with confining pressures to about 7 kilobars. Tests were conducted on normal rock and similar rock subjected to prior shock pressure of about 20 and 40 kb. At or near atmospheric confining pressure, the mode of failure ranged from brittle shear for normal rock to crumbling for severely preshocked rock. Between 1/2- and 3-1/2-kb confining pressure, all specimens failed by a quiet slip shear and showed similar strength. Beyond 3-1/2-kb confining pressure, all specimens failed by an abrupt brittle shear and showed similar strength. Failures under confining pressures typically were along a single shear surface inclined 30 deg to the longitudinal axis. Plastic deformation was not observed. Slip failures occurred when the total bulk Coulomb strength of the stressed rock remained less than the Coulomb fundamental cohesive strength. Beyond this point, a rebounding mechanism apparently produced an appreciably stronger material with a brittle failure mode. The termination of the quiet slip mode of failure at 3-kb confining pressure agrees with theoretically derived conditions for the collapse of shallow small cracks. (USBR)
W69-06701

DETERMINATION OF STRESSES IN THE ARCH OF LARGE UNDERGROUND STRUCTURES, APPEARING AT THE TIME OF EXCAVATION OF THE CORE,
N. S. Chetyrkin.
Soil Mech Found Eng, No 4, pp 266-272, July-Aug 1968. 7 p, 4 fig, 1 tab, 7 ref.

Descriptors: *Arch, Concrete structures, *Stress analysis, Structural analysis, Stress concentration, Stress distribution, Structural design, Structural engineering, Foreign design practices, Tunnel pressures, Rock excavation, *Underground powerplants, *Underground structures.
Identifiers: Arch action, Arching, Concrete linings, Rock pressures, USSR, Underground openings, Subsurface openings, Tunnel supports.

When constructing a large underground structure, the top heading is first excavated and then a concrete arch is constructed. The arch is grouted to achieve full contact with the rock mass, and then the main heading is excavated. Elastic deformations of the rock mass begin almost immediately and practically vanish when the arch starts working. The rock load taken by the concrete arch results from the interaction between the rock mass and the lining, as variations in the state of stress of the rock mass arise from excavation of the main heading. A method is presented for determining these stresses. Results are given from a determination of the stresses in the arch of a large underground powerhouse. (USBR)
W69-06706

8F. Concrete

TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
V. M. Moskvin, M. M. Kapkin, and B. M. Mazur.
Transl from Gidrotekh Stroit, No 6, pp 17-20, 1964. Bur Reclam Transl 534, Apr 1966. 22 p, 5 fig, 2 tab, 17 ref.

Descriptors: Deformation, Volume, *Temperature, Autoclaves, *Concrete testing, Concrete technology, Concrete structures, *Reinforced concrete, Curing, Steam curing, Moisture content, *Freezing, Hydrostatic pressure, *Freeze thaw tests, Expansion, Contractions, Cooling, Bibliographies, Shrinkage, Concretes, Cold weather construction, *Thermal expansion.
Identifiers: USSR, Frost resistance, Foreign testing, *Volume change, Cold climates, Concrete properties.

Volume changes in normally cured, steam-cured, and autoclaved concretes were measured in a controlled temperature cabinet having a range of+100 to -70 deg C. At subzero temperatures the linear expansion coefficient of concrete fluctuates in relation to (1) the degree of temperature lowering and water saturation, (2) the water-cement ratio, and (3) the curing preliminary to testing. Residual volumetric deformations accumulated during freezing and thawing cycles can exceed the expansion limit of concrete. Temperature expansion of steam-cured and autoclaved concretes is significantly higher than that for normally cured concretes of the same mix. Raising the water-cement ratio increases expansion and the accumulated residual volume changes. Conflicting volume changes of concrete and steel under given conditions can lead to significant stresses in reinforced concrete, requiring further study of reinforced concrete behavior at low subzero temperatures. Peculiarities of subzero temperature deformation of concrete shown by these tests should be included in designs for reinforced concrete hydraulic structures in severe climates and particularly in prefabricated reinforced concrete structures. (USBR)
W69-06672

SHEAR TRANSFER IN REINFORCED CONCRETE,
Naval Air Station, Moffet Field, Calif.; Ministry of Works (Sudan); and Washington Univ., Seattle.
J. A. Hofbeck, I. O. Ibrahim, and Alan H. Mattock.
J Amer Concr Inst, No 2, Proc V 66, pp 119-128, Feb 1969. 10 p, 11 fig, 2 tab, 6 ref.

Descriptors: *Reinforced concrete, Shear strength, Shear resistance, Composite structures, Connectors (Mechanical), Precast concrete, Shear, *Shear planes, Shear strain, Shear stress, *Shear tests, Reinforcement, Beams (Structural), Structural behavior, Cracking, Mohr failure theory, Dowels, Slipping.
Identifiers: Ultimate shear stresses, Ultimate strength, Stirrups, Slip surface.

In some situations shear failure is constrained to occur along a plane, as at the interface between a precast beam and a cast-in-place deck slab, or at certain locations in precast concrete connections. Transferring shear across such a plane is called shear transfer, to distinguish this type of shearing action from the type that usually occurs in a reinforced concrete beam. Thirty-eight pushoff specimens (some with and some without a preexisting crack along the shear plane) were tested. A preexisting crack along the shear plane will reduce the ultimate shear transfer strength and increase slip at all load levels. Dowel action of reinforcing bars crossing the shear plane is insignificant in initially uncracked concrete, but is substantial in concrete with a preexisting crack along the shear plane. The shear-friction theory gave a conservative estimate of shear transfer strength of initially cracked concrete. A method, based on the Zia envelope to Mohr circles representing failure conditions for concrete, is presented for calculating shear transfer strength in initially uncracked concrete. (USBR)
W69-06676

RX CONCRETE,
Sidney Freedman.
Mod Concr, Vol 32, No 10, pp 31-37, Feb 1969. 5 p, 1 fig, 13 ref.

Descriptors: *Concrete testing, Concrete technology, Concretes, Cores, Concrete structures, Compressive strength, Core drilling, Calibrations, Hardness tests, Impact tests, Field tests, *Non-destructive tests.
Identifiers: Ultrasonic impulse method, Soniscopes, Impact hammers, Pulse velocity tests, Schmidt test hammer, Test hammers.

Field methods for measuring concrete strength discussed are: drilled cores, cast-in-place pushout cores, Swiss hammer, Windsor test probe, and ultrasonic pulse velocity. Core strengths are affected by orientation of drilling, embedded reinforcement, specimen size, moisture content, and curing conditions. The calibration and test procedure of the Swiss hammer are covered. The Windsor probe, a recently developed hardness tester, is compared with the Swiss hammer. The ultrasonic pulse velocity method is explained; concrete variables affecting pulse velocity are listed. Pulse velocity may be used to assess concrete uniformity but should not be used to measure strength unless a velocity-strength calibration curve is obtained from concrete cylinders made from the concrete mix used on the structure. Nondestructive testing of field structures requires an accurate knowledge of factors affecting test results; trying to develop general relationships for all concrete on the basis of any nondestructive test is dangerous. (USBR)
W69-06678

USE OF ASPHALTIC CONCRETE IN COASTAL AND CANAL CONSTRUCTION,
Hans Mosslang.
Transl from Die Wasserwirt, Vol 58, No 9, pp 258-260, 1968. Bur Reclam Transl 805, Feb 1969. 9 p, 7 fig, 2 ref.

Descriptors: *Asphaltic concrete, Asphalt, *Canal linings, Bituminous materials, Coastal structures, Coastal engineering, *Dikes, Wave action, Foreign construction, Foreign design practices, Embankments, *Paving, *Shore protection, Mechanization, *Bank protection, *Levees.
Identifiers: Navigable canals, Protective coverings, West Germany.

Two notable asphaltic concrete hydraulic structures were built in 1967: a 4.5-km ring dike around an artificial island in the middle of the Eider estuary on the west coast of Schleswig-Holstein, and the Hausen reach of the Rhein-Main-Danube large-vessel navigation canal. The dike, designed to withstand North Sea hurricane tides, was built to protect the artificial island from the damming of the Eider River. The dike has a crest height of 7.5 to 7.8 m, a slope of 1:4, and an asphaltic concrete layer from 40 cm to 15 cm thick at the crest. The Hausen reach of the navigation canal is completely lined with asphaltic concrete and is designed for watertightness and protection of the banks from bumps and water waves from 1350-ton ships. Some design details for the asphaltic concrete linings and mechanized paving operations are discussed. (USBR)
W69-06682

DETERMINATION OF STRESSES IN THE ARCH OF LARGE UNDERGROUND STRUCTURES, APPEARING AT THE TIME OF EXCAVATION OF THE CORE,
For primary bibliographic entry see Field 08E.
W69-06706

THERMAL STRESS CONDITION OF EXPERIMENTAL LONG BLOCKS DURING CONSTRUCTION PERIOD OF THE BRATSK HYDROELECTRIC STATION DAM,
S. Ya Eidel'man, and G. M. Makedonskii.
Hydrotech Constr, No 5, pp 397-404, May 1968. 8 p, 7 fig, 3 tab, 6 ref.

Descriptors: *Concrete construction, Concrete mixes, Concrete placing, Concrete structures, Concrete technology, Concrete testing, Monoliths, Foreign construction, *Mass concrete, Cold weather construction, Thermal expansion, Thermal properties, *Thermal stress, Temperature, Cooling, Heating, Cracking, Stress distribution.
Identifiers: *Concrete blocks, Concrete properties, Bratsk Powerplant (USSR), *Thermal gradients, Temperature distribution, USSR.

Experimental studies were made of the temperature and thermal stress in long concrete blocks at the Bratsk hydroelectric plant. Details of the investigation and results of tests are given. On-site investigations confirmed results from the long experimental blocks. Maintaining temperatures as determined by the experimental long blocks assures favorable development of thermal stresses, but large temperature drops result in surface cracks along edges. A thermal stress field in a monolith is caused by overall cooling and nonuniform temperature distribution. Favorable factors are (1) minimum temperature differences between adjacent blocks, (2) low concrete mix temperatures, and (3) prolonged exothermic heating. These factors develop compressive stresses, compensating for tensile stresses arising from cooling the blocks and prevent cracks from forming in the central zone of the monolith. Stresses in the reinforcement of the plate separating long blocks from columnar blocks reach high magnitudes because of seasonal openings of the intercolumnar joints covered by the plate, and should be taken into account in calculating the reinforcement. (USBR)
W69-06711

THE MECHANISM OF WATER SEEPAGE THROUGH CONCRETE,
A. P. Kirillov.
Hydrotech Constr, No 5, pp 411-415, May 1968. 5 p, 4 fig, 1 tab.

Descriptors: *Seepage, Seepage losses, Permeability, Plugs, Hydration, Pores, Concretes, *Concrete technology, Concrete testing, Pressure head, Concrete structures, Concrete pipes, Hydrostatic pressure, Percolation, Percolating water.
Identifiers: Permeability tests, Permeability coefficients, USSR, Foreign testing, Cement hydration, Concrete properties.

Water seepage through concrete varies with time. Laboratory tests show that seepage initially increases, then decreases, and tends to stabilize after about 15 days. Field observations of pipelines, reservoirs, and other structures operating under water pressure show that seepage diminishes with time and may completely cease. The processes causing increases and decreases in seepage rates are discussed. Internal sealing is the principal cause of reducing permeability of old concrete; in younger concrete, secondary hydration also reduces seepage. After prolonged seepage, seepage decreases with an increased pressure gradient. Concrete of a given composition has a limiting minimum value for the seepage coefficient; after this value is reached, the coefficient remains nearly constant for any gradient. Concrete permeability diminishes continually during the initial seepage period; the seepage coefficient reached after a period of time under a given pressure gradient is significantly lower than the initial value. (USBR)
W69-06712

8H. Rapid Excavation

NUCLEAR EXPLOSIVES,
California Univ., Livermore. Lawrence Radiation Lab.
Gerald W. Johnson.
For main entry see Field 06B, W69-06572.
Proceedings of a Conference at University of California at Davis, pp 147-153, Jan 11-13, 1961. 7 p, 1 tab, 1 ref.

Descriptors: *Nuclear explosions, Explosives, Excavation, Water resources development.
Identifiers: Plowshare Program, Project Chariot.

Through an active research program, it may be possible to find ways to use nuclear explosives in water development projects. In some projects, such as floodwater diversion, the excavation requirement is simply for a large hole. For this situation the cost advantage of nuclear explosives would be a maximum. Where it is necessary to obtain both a definite width and depth for a project, conventional excavation methods may be more economical. There are two other possible uses for nuclear explosives: (1) the displacement of material down a slope in order to expose ore bodies, to produce fill, or to provide earth dams; (2) the fracturing or shattering of a large formation in order to permit subsequent removal or perhaps to increase its permeability for such purpose as water storage. (Winn-Rutgers)
W69-06581

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

MANPOWER REQUIREMENTS FOR POLLUTION CONTROL AND WATER RESOURCES IN INDIANA AND A RELATED POLLUTION CONTROL TECHNOLOGY CURRICULUM,
Purdue Univ., Lafayette, Ind.
For primary bibliographic entry see Field 05G.
W69-06507

9C. Research Facilities

REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
Fish and Wildlife Service, Washington D. C.; and Bureau of Commercial Fisheries, Washington, D. C.
James E. Sykes.
U S Fish and Wildlife Serv Circ 313, May 1969. 25 p, 19 fig, 8 tab.

Descriptors: *Estuaries, *Aquatic habitats, *Estuarine environment, *Estuarine fisheries, *Florida Oceanography, Water quality, Fish, Fisheries, Commercial fishing, Fishkill.
Identifiers: *Bureau of Commercial Fisheries (U.S.).

The major goals of the Bureau of Commercial Fisheries Biological Laboratory are to explore the relatively unknown scope of biological productivity in the coastal zone of the eastern Gulf of Mexico, to measure the effect of changes in that zone, and to develop methods of increasing estuarine fishery resources. Current research on projects in the Estuarine, Red-Tide, and Industrial Schoolfishes Programs is described. The projects include studies of sediments and organisms in bay bottoms, plankton crops and fishes residing in and transferring between estauaries and the Gulf of Mexico, toxicity of the red-tide organism, and experimental rearing of pompano in an impounded lagoon. A physical, hydrological, biological, and sedimentological inventory of Florida estuaries is also in progress as part of a cooperative effort with the National Oceanographic Data Center and the States of Alabama, Mississippi, and Louisiana. (Knapp-USGS).
W69-06767

PROGRESS REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY, BEAUFORT, N. C., FISCAL YEAR 1968,
Bureau of Commercial Fisheries, Beaufort, N. C. Radiobiological Lab.
T. R. Rice.
Dept of Interior - Bur of Com Fish Circ No 309, Apr 1969. 59 p, 32 fig, 12 tab.

Descriptors: *Radioecology, *Research facilities, *Radioactivity effects, *Environmental effects, Biology, Commercial fishing, Estuaries, Radiosensitivity, Water pollution effects, Laboratories.
Identifiers: *Radioecological research.

Radiobiological Laboratory is concerned with the fate of radioactive materials in the estuarine environment, and the effect of radiation on marine organisms, and the application of radioactive tracer techniques to fishery biology. To obtain the data pertinent to these problems, many data were collected in the laboratory to use to predict the fate of radioactive materials introduced into the marine environment, tanks and ponds were used to test questionable findings obtained in the laboratory, and the cycling of radioisotopes in certain natural bodies of water, restricted from the public, is observed. Data collected by these 3 approaches, when integrated and correlated, will make for a better understanding of the role of plants and animals in the cycling of radioactivity in estuaries and marine areas. (Knapp-USGS)
W69-06769

9D. Grants, Contracts, and Research Act Allotments

WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF ENGINEERS IN COLORADO.
Corps of Engineers, Omaha, Nebr.

Missouri River Div, Corps Eng Water Resources Develop Rep, Jan 1969. 22 p, 3 fig, 1 map, 3 photo.

Descriptors: *Water management (Applied), *Colorado, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U S Army Corps of Engineers projects (Colo).

U. S. Army Corps of Engineers water resources development projects in Colorado are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include naviation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W69-06782

WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF ENGINEERS IN DELAWARE.
Corps of Engineers, Philadelphia, Pa.

N Atlantic Div, Corps Eng Water Resources Develop Rep, Jan 1969. 36 p, 17 photo, 1 tab, 3 chart, 1 exhibit, index.

Descriptors: *Water management (Applied), *Water resources development, *Delaware, Navigation, River basin development, Beach erosion, Flood control.
Identifiers: U S Army Corps of Engineers projects (Del).

The water resources activities of the U. S. Army Corps of Engineers in Delaware as of Jan 1, 1969 are reviewed. The projects include navigation, river

basin development, beach protection, water resources investigations, and flood control. (K-napp-USGS)
W69-06783

WATER RESOURCES DEVELOPMENT IN MINNESOTA.
Corps of Engineers, Chicago, Ill.

Corps Eng Water Resources Rep, 1969. 56 p, 4 map, 19 photo.

Descriptors: *Water management (Applied), *Water resources, *Minnesota, Navigation, River basin development, Erosion control, Flood control.
Identifiers: U. S. Army Corps of Engineers projects (Minn).

Water resources activities by the U. S. Army Corps of Engineers in Minnesota as of 1 January 1969 are reviewed. Projects include navigation, flood control, flood plain studies, and river basin studies. (K-napp-USGS)
W69-06784

10. SCIENTIFIC AND TECHNICAL INFORMATION

PERMUTED TITLE INDEX TO WATER RESEARCH JOURNALS, 1967.
Cornell Univ., Ithaca, N. Y. Water Resources and Marine Sciences Center.

Water Resources Scientific Information Center, US Dept of Interior, 394 p.

Descriptors: *Bibliographies, *Water resources, Reviews, Publications, Documentation.
Identifiers: *Current awareness, KWIC index, Cornell Univ Water Resources and Marine Sciences Ctr.

This report, a product of the current-awareness service operated by Water Resources and Marine Sciences Center of Cornell University, is comprised of a computer-generated key-word-in-context (KWIC) index of some 10,547 entries covering 167 serials and 1670 individual citations published or otherwise appearing in 1967. Publication contains a foreword, instructions for use, a list of journals screened, the KWIC index, and a citation list indexed by indentification numbers referred to in the KWIC index. (Eichhorn-Wis)
W69-06539

A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
Research Council of Alberta, Edmonton.
For primary bibliographic entry see Field 07C.
W69-06764

WATER FOR TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 06B.
W69-06790

SUBJECT INDEX

ABANDONMENT
EARLE V MCCARTY (TITLE TO LAND BETWEEN SOUND AND DEDICATED ROAD).
W69-06646 06E

ACCRETION(LEGAL ASPECTS)
LAWKINS V CITY OF NEW YORK (EROSION AND ACCRETION OF BOUNDARY SHORE LINE).
W69-06606 06E

BALL CREEK COAL CO V NAPIER (MEANDERS AS A BOUNDARY).
W69-06614 06E

ERICKSON V GREUB (TITLE TO ACCRETION).
W69-06641 06E

ADKINS V HUGHES (BOUNDARY DISPUTE DUE TO AVULSION).
W69-06658 06E

ACID MINE WATER
EFFECTS OF MINE DRAINAGE ON GROUND WATER,
W69-06425 05C

ADJUDICATION
GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06666 06E

ADJUDICATION PROCEDURE
GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06662 06E

GENERAL PROVISIONS, REGULATING TO RIVERS AND STREAMS.
W69-06664 06E

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06665 06E

W69-06667 06E

W69-06668 06E

W69-06669 06E

W69-06671 06E

ADMINISTRATIVE AGENCIES
CONSERVATION'S CHALLENGE TO STATE GOVERNMENTS,
W69-06586 06E

RUSSELL V STATE (ILLEGAL POSSESSION OF UNDERSIZED FISH).
W69-06589 06E

WHITE OAK BOROUGH AUTH V PENN PUB U COMM'N (AQUISITION OF PUBLIC WATER FACILITIES).
W69-06601 06E

WATERS AND WATER SUPPLY.
W69-06612 06E

SEWERAGE DISTRICTS AND BOARDS.
W69-06632 05G

FLOOD WALL BOARD.
W69-06647 06E

ADMIRALTY
PETITION OF MARTIN (OBSTRUCTION TO NAVIGATION).
W69-06636 06E

ADVERSE POSSESSION
SBARRA V ERIE RR (DRAINAGE OF SURFACE WATERS AND PRESCRIPTIVE RIGHTS).
W69-06591 06E

AERIAL PHOTOGRAPHY
GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
W69-06681 07B

SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

COMPUTER-AIRPLANE COMBO SAVES QUARTER MILLION DOLLARS ON SURVEYS AND ADMINISTRATION OF CONSTRUCTION CONTRACTS,
W69-06697 07B

AFRICA
GROUND WATER, GRAVITY AND RIFT VALLEYS IN MALAWI,
W69-06431 02F

AGGREGATE KOYCK FUNCTION
AGGREGATE KOYCK FUNCTIONS,
W69-06561 06B

AGRICULTURE
THE COMPETITION FOR WATER QUANTITY AGRICULTURE,
W69-06575 06D

AGRO-INDUSTRIAL COMPLEXES
DESALTED SEAWATER FOR AGRICULTURE IS IT ECONOMIC,
W69-06765 03F

AIRCRAFT
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

ALABAMA
WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
W69-06451 02E

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

UNITED STATES V TURNER (OWNERSHIP OF BEDS UNDER SHALLOW WATERS).
W69-06628 06E

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
W69-06815 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
W69-06816 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
W69-06817 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
W69-06818 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
W69-06819 02F

ALASKA
RECENT HISTORY OF GULKANA AND COLLEGE GLACIERS, CENTRAL ALASKA RANGE, ALASKA,
W69-06808 02C

ALBEDO
THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

ALGORITHMS
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

ALKALINE SOILS
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W69-06716 03F

ALLUVIAL CHANNELS
DYNAMICS OF CHANNEL FLOW,
W69-06835 02E

ALLUVIUM
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

ALPINE GLACIER BUDGET
RELATIONS BETWEEN GLACIER RUNOFF AND METEOROLOGICAL FACTORS OBSERVED ON AND OUTSIDE THE GLACIER,
W69-06481 02C

ALSACE(FRANCE)
THE USE OF ELECTRIC ANALOG MODELS IN HYDRODYNAMICAL STUDY OF THE ALSACE AQUIFERS (FRENCH),
W69-06806 02F

ALTERNATING CURRENT
CALCULATION OF BALANCED AND UNBALANCED FAULT CURRENTS IN AC-DC POWER SYSTEMS,
W69-06690 08C

ALTERNATIVE COSTS
SLUDGE DISPOSAL ALTERNATIVES -- SOCIO-ECONOMIC CONSIDERATIONS,
W69-06492 05E

THE ROLE OF ALTERNATIVE COST IN PROJECT DESIGN AND SELECTION,
W69-06738 06B

ANALOG COMPUTERS
DYNAMIC SIMULATION MODEL OF THE TRANSPIRATION PROCESS,
W69-06504 02D

ANALOG MODELS
ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
W69-06509 02F

ANALYSICAL TECHNIQUES
FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-III. A STUDY OF PHENOL CONTENT IN SURFACE WATERS,
W69-06444 05A

ANALYTICAL TECHNIQUES
A SIMPLIFIED TECHNIQUE FOR WELL-FIELD DESIGN,
W69-06421 02F

EXTENDED TECHNIQUES OF CALCULATION OF SOIL-WATER MOVEMENT, WITH SOME PHYSICAL CONSEQUENCES,
W69-06714 02G

ANTARCTIC ICE CAP
THE ANNUAL HEAT ENERGY TRANSFER ABOVE AND INSIDE ANTARCTICA BLUE ICE,
W69-06480 02C

APPLICATION EQUIPMENT
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

APPROPRIATION
STATE V CITY OF CLEVELAND (RIGHT OF ACCESS TO NAVIGABLE WATERS).
W69-06619 06E

AQUATIC HABITATS
REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
W69-06767 09C

AQUATIC WEED CONTROL
ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

AQUIFER
ARTIFICIAL RECHARGE TO THE EDWARDS LIMESTONE AQUIFER IN SOUTH TEXAS,
W69-06483 04B

AQUIFER CHARACTERISTICS
GEOLOGY, DESIGN, AND CONSTRUCTION OF DEEP WELLS IN SEDIMENTARY FOUNDATIONS,
W69-06759 02F

AQUIFERS
CONTROL OF SEA-WATER INTRUSION IN A GROUND-WATER AQUIFER,
W69-06422 02F

CONCEPTUAL MODELS FOR CARBONATE AQUIFERS,
W69-06423 02F

ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
W69-06512 02G

THE USE OF ELECTRIC ANALOG MODELS IN HYDRODYNAMICAL STUDY OF THE ALSACE AQUIFERS (FRENCH),
W69-06806 02F

RANDOM PROCESSES AND LITHOLOGIC TRANSITIONS,
W69-06807 02J

ARCH
DETERMINATION OF STRESSES IN THE ARCH OF LARGE UNDERGROUND STRUCTURES, APPEARING AT THE TIME OF EXCAVATION OF THE CORE,
W69-06706 08E

AREAL RAINFALL
FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL, U.S. COASTAL REGION, GULF OF MEXICO,
W69-06797 02B

ARID CLIMATE
SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
W69-06524 02G

ARID CLIMATES
EVALUATION OF SOME PRACTICAL METHODS OF ESTIMATING EVAPOTRANSPIRATION IN ARID CLIMATES AT LOW LATITUDES,
W69-06530 02D

ARID LANDS
MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
W69-06454 03F

ARIZONA
GROUNDWATER IN FRACTURED VOLCANIC ROCKS IN SOUTHERN ARIZONA,
W69-06831 02F

ARKANSAS
HARRELL V CITY OF CONWAY (USE OF IMPOUNDED WATER).
W69-06597 06E

HARRIS V BROOKS (RECREATION RIGHTS OF RIPARIAN OWNER).
W69-06599 06E

OWEN V JOHNSON (OWNERSHIP OF THE BED OF A NAVIGABLE STREAM).
W69-06639 06E

ARSENIC COMPOUNDS
ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

ARTIFICIAL PRECIPITATION
ON THE DISTRIBUTION OF STATISTICS SUITABLE FOR EVALUATING RAINFALL STIMULATION EXPERIMENTS,
W69-06679 03B

ARTIFICIAL RECHARGE
ARTIFICIAL RECHARGE TO THE EDWARDS LIMESTONE AQUIFER IN SOUTH TEXAS,
W69-06483 04B

ARTIFICIAL RECHARGE OF A FISSURED SANDSTONE AQUIFER, TANGIERS, MOROCCO (FRENCH),
W69-06487 04B

ASPHALTIC CONCRETE
USE OF ASPHALTIC CONCRETE IN COASTAL AND CANAL CONSTRUCTION,
W69-06682 08F

ATLANTIC COUNTY(NJ)
SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

ATTERBERG LIMITS
PREDICTION OF SWELLING PRESSURE OF CLAYS,
W69-06693 08D

AUGER HOLES
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

AUSTRALIA
PREDICTION OF RAINSPLASH EROSION IN THE SEASONALLY WET TROPICS,
W69-06768 02J

IMPROVED TECHNIQUES FOR ESTIMATING RUNOFF WITH BRIEF RECORDS,
W69-06830 02E

AUTOCORRELATED DISTURBANCES
TESTING SINGLE-EQUATION LEAST SQUARES REGRESSION MODELS FOR AUTOCORRELATED DISTURBANCES,
W69-06565 06A

AUTOREGRESSIVE RESIDUALS
SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
W69-06567 06A

BALCONES FAULT ZONE
ARTIFICIAL RECHARGE TO THE EDWARDS LIMESTONE AQUIFER IN SOUTH TEXAS,
W69-06483 04B

BANK PROTECTION
USE OF ASPHALTIC CONCRETE IN COASTAL AND CANAL CONSTRUCTION,
W69-06682 08F

BARGES
SOUTHERN TRANSPORTATION CO V CITY OF NEW YORK (NEGLIGENCE OF BRIDGE OPERATOR AND TUG MASTER CAUSING BARGE COLLISION).
W69-06638 06E

BAROMETRIC EFFICIENCY
A RIGID PLATE MODEL OF THE BAROMETRIC EFFECT,
W69-06775 02F

BARRIERS
FLOOD WALL BOARD.
W69-06647 06E

BASALTS
SOME DETAILS ON THE CIRCULATION OF GROUNDWATER IN NON-KARSTIFIED FISSURED FORMATIONS IN CZECHOSLOVAKIA (FRENCH),
W69-06485 02F

BASE FLOW
PRECIPITATION AND BASE FLOW VARIABILITY,
W69-06443 02B

BAYS
CALIFORNIA CO V PRICE (OWNERSHIP OF NAVIGABLE WATER BED).
W69-06613 06E

BEACH EROSION
LAWKINS V CITY OF NEW YORK (EROSION AND ACCRETION OF BOUNDARY SHORE LINE).
W69-06606 06E

TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A CARBONATE BEACH, BIMINI, BWI,
W69-06809 02L

BEACH STRATIGRAPHY
COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
W69-06798 02L

BEACHES
COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
W69-06798 02L

TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A CARBONATE BEACH, BIMINI, BWI,
W69-06809 02L

BEDS
BAILEY V DRISCOLL (IMPLIED LIMITATION ON GRANT OF SUBMERGED LAND).
W69-06618 06E

BEDS UNDER WATER
XIDIS V CITY OF GULFPORT (USE OF SUBMERGED LANDS FOR PUBLIC PURPOSE).
W69-06621 06E

BENEFICIAL USE
BENEFICIAL USES OF WATERS OF INTERNATIONAL RIVERS INTERNATIONAL LAW AND PRACTICE,
W69-06458 06E

BIBLIOGRAPHIES
PERMUTED TITLE INDEX TO WATER RESEARCH JOURNALS, 1967.
W69-06539 10

BIMINI(BWI)
TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A

CARBONATE BEACH, BIMINI, BWI,
W69-06809 02L

BIOTA
NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
W69-06766 05A

BODIES OF WATER
JURISDICTION OVER WATERS.
W69-06634 06E

BOND ISSUE
XIDIS V CITY OF GULFPORT (USE OF SUBMERGED LANDS FOR PUBLIC PURPOSE).
W69-06621 06E

BOREHOLES
RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
W69-06820 02F

BOULE FLOTATION
BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
W69-06840 03A

BOUNDARIES(PROPERTY)
LEONARD V STATE HIGHWAY DEPT (ACQUISITION OF TITLE BY STATE THROUGH PERMANENT FLOODING OF LAND).
W69-06611 06E

CALIFORNIA CO V PRICE (OWNERSHIP OF NAVIGABLE WATER BED).
W69-06613 06E

BALL CREEK COAL CO V NAPIER (MEANDERS AS A BOUNDARY).
W69-06614 06E

OWEN V JOHNSON (OWNERSHIP OF THE BED OF A NAVIGABLE STREAM).
W69-06639 06E

EARLE V MCCARTY (TITLE TO LAND BETWEEN SOUND AND DEDICATED ROAD).
W69-06646 06E

HAMMEL V CAMP RANGER, INC (PRESUMPTIONS REGARDING CONVEYANCE OF INLAND, NON-NAVIGABLE POND).
W69-06648 06E

BOUNDARIES(SURFACES)
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

LAWKINS V CITY OF NEW YORK (EROSION AND ACCRETION OF BOUNDARY SHORE LINE).
W69-06606 06E

BOUNDARY DISPUTES
HAMMEL V CAMP RANGER, INC (PRESUMPTIONS REGARDING CONVEYANCE OF INLAND, NON-NAVIGABLE POND).
W69-06648 06E

SKALITSKY V CONSOL BADGER CO-OPERATIVE (OWNERSHIP OF FILLED POND BED).
W69-06650 06E

ADKINS V HUGHES (BOUNDARY DISPUTE DUE TO AVULSION).
W69-06658 06E

BRIDGES
SOUTHERN TRANSPORTATION CO V CITY OF NEW YORK (NEGLIGENCE OF BRIDGE OPERATOR AND TUG MASTER CAUSING BARGE COLLISION).
W69-06638 06E

BRINE DISPOSAL
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W69-06837 03A

BRINES
A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS PART 1,
W69-06556 03C

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

BRITTLE FAILURES
BRITTLE ROCK FAILURE UNDER TRIAXIAL STRESS,
W69-06701 08E

BULKHEAD LINE
UNITED STATES V GROEN (TITLE TO FILLED IN LAND BORDERING ON A RIVER).
W69-06608 06E

BUREAU OF COMMERCIAL FISHERIES(U
REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
W69-06767 09C

BUREAU OF RECLAMATION
KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

BURNING
FIRES.
W69-06598 06E

BY-PRODUCTS
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W69-06837 03A

RECOVERY OF SALTS FROM SALINE WATER VIA SOLVENT EXTRACTION (FINAL REPORT),
W69-06839 03A

CABLES
BELL TEL CO V DRAVO CORP (UNDERWATER OBSTRUCTION TO NAVIGATION).
W69-06610 06E

PETITION OF MARTIN (OBSTRUCTION TO NAVIGATION).
W69-06636 06E

CALIBRATIONS
RESPONSE OF BUBBLE-GAGE SERVOMANOMETERS TO OSCILLATIONS IN WATER LEVEL,
W69-06434 07C

CALIFORNIA
CONTROL OF SEA-WATER INTRUSION IN A GROUND-WATER AQUIFER,
W69-06422 02F

SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
W69-06424 06A

THE COMPETITION FOR WATER QUANTITY AGRICULTURE,
W69-06575 06D

THE COMPETITION FOR WATER QUANTITY INDUSTRY,
W69-06577 06D

FLOOD PLAIN INFORMATION OF SPRING VALLEY CREEK, SAN DIEGO COUNTY, CALIFORNIA.
W69-06824 04A

SYSTEMS APPROACH FOR INTEGRATING GROUND WATER AND SURFACE WATER USE.
W69-06834 06A

CANADA
THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

CLIMATOLOGY STUDIES OF BAFFIN ISLAND, NORTHWEST TERRITORIES,
W69-06814 02B

CANAL LININGS
USE OF ASPHALTIC CONCRETE IN COASTAL AND CANAL CONSTRUCTION,
W69-06682 08F

CANALS
A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
W69-06461 04A

CANONICAL CORRELATION
CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS IN ECONOMICS,
W69-06735 06B

CAPACITORS
SHUNT CAPACITOR ENERGIZATION WITH VACUUM INTERRUPTERS--A POSSIBLE SOURCE OF OVERVOLTAGE,
W69-06689 08C

CAPILLARY CONDUCTIVITY
SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD,
W69-06528 02G

CARBONATE AQUIFERS
CONCEPTUAL MODELS FOR CARBONATE AQUIFERS,
W69-06423 02F

CATHODIC PROTECTION
INNOVATIONS AND THE FUTURE OF CATHODIC PROTECTION,
W69-06677 08A

CAVITATION
COMPUTATION OF PRESSURES AND VELOCITIES IN THE CURVILINEAR ZONE OF PRESSURE SPILLWAYS, FOR PREDICTING CAVITATION,
W69-06713 08B

CES PRODUCTION FUNCTION
THE CES PRODUCTION FUNCTION A DERIVATION,
W69-06720 06B

ESTIMATION OF RETURNS TO SCALE AND THE ELASTICITY OF SUBSTITUTION,
W69-06732 06B

CHANNEL ALTERATION
SEWERAGE DISTRICTS AND BOARDS.
W69-06633 06E

CHANNEL FLOW
HEC-2, WATER SURFACE PROFILES.
W69-06787 04A

DYNAMICS OF CHANNEL FLOW,
W69-06835 02E

CHANNEL IMPROVEMENT
TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMM'N (PIPELINES ACROSS NAVIGABLE CHANNELS).
W69-06587 06E

FONADELLAS V UNITED STATES (TEMPORARY TAKING OF PROPERTY FOR PUBLIC PURPOSE).
W69-06622 06E

CHELATION
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W69-06837 03A

CHEMICAL ANALYSIS
GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

CHESAPEAKE BAY
CHESAPEAKE BAY CASE STUDY.
W69-06794 06B

CHLORIDES
STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

CIRCUIT BREAKERS
OPEN BREAKER PROTECTION OF EHV SYSTEMS,
W69-06688 08C

CITIES
FIRES.
W69-06598 06E

HARDY V KANSAS CITY (FLOODING CAUSED BY OBSTRUCTION TO WATER FLOW).
W69-06625 06E

SOUTHERN TRANSPORTATION CO V CITY OF NEW YORK (NEGLIGENCE OF BRIDGE OPERATOR AND TUG MASTER CAUSING BARGE COLLISION).
W69-06638 06E

DAVIS V CITY OF ALEXANDRIA (PUBLIC USE OF LEVEE BANK AS ROADWAY).
W69-06645 06E

CIVIL ENGINEERING
CIVIL ENGINEERING AND URBAN SYSTEMS,
W69-06491 06A

CLAY MINERALS
POTASSIUM, ILLITE AND THE OCEAN,
W69-06506 02K

CLAYS
PREDICTION OF SWELLING PRESSURE OF CLAYS,
W69-06693 08D

CLIMATIC DATA
THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

ESTIMATING PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
W69-06522 02D

CLIMATIC ZONES
SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
W69-06524 02G

CLIMATOLOGY
FURTHER STUDIES OF DROUGHT OVER NORTHEASTERN UNITED STATES,
W69-06438 02B

SOME REMARKS ON THE PREDICTABILITY OF DROUGHT AND RELATED CLIMATIC ANOMALIES,
W69-06439 02B

THE ANNUAL HEAT ENERGY TRANSFER ABOVE AND INSIDE ANTARCTICA BLUE ICE,
W69-06480 02C

THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

CLIMATOLOGY STUDIES OF BAFFIN ISLAND, NORTHWEST TERRITORIES,
W69-06814 02B

CLOUD SEEDING
ON THE DISTRIBUTION OF STATISTICS SUITABLE FOR EVALUATING RAINFALL STIMULATION EXPERIMENTS,
W69-06679 03B

REGIONAL HYDROLOGIC AREA STUDY AS AN ANALYSIS TOOL IN WEATHER MODIFICATION,
W69-06805 02A

COASTAL PLAINS
ECONOMIC ANALYSIS OF THE DEVELOPMENT POTENTIAL OF THE COMMERCIAL FISHERIES INDUSTRY OF THE COASTAL PLAINS REGION,
W69-06554 06B

COBB-DOUGLAS PRODUCTION FUNCTION
SPECIFICATION AND ESTIMATION OF COBB-DOUGLAS PRODUCTION FUNCTION MODELS,
W69-06560 06A

COLOR
SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

COLOR PHOTOGRAPHY
SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

COLORADO
WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF ENGINEERS IN COLORADO.
W69-06782 09D

COLORIMETRY
FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-III. A STUDY OF PHENOL CONTENT IN SURFACE WATERS,
W69-06444 05A

COMMERCIAL FISHING
RUSSELL V STATE (ILLEGAL POSSESSION OF UNDERSIZED FISH).
W69-06589 06E

HAYNES V SMITH (PRIVATE COMMERCIAL VENTURES ON PUBLIC WATERS).
W69-06643 06E

COMMUNITY STRUCTURE
SPECIES DIVERSITY AND COMMUNITY STRUCTURE IN LACUSTRINE PHYTOPLANKTON,
W69-06542 02H

COMPENSATION
IOWA-WISCONSIN BRIDGE CO V UNITED STATES (LIABILITY FOR RESERVOIR OPERATION).
W69-06604 06E

FONADELLAS V UNITED STATES (TEMPORARY TAKING OF PROPERTY FOR PUBLIC PURPOSE).
W69-06622 06E

COMPUTER PROGRAMS
PIPELINE PLANNING BY DYNAMIC COMPUTER PROGRAMMING,
W69-06493 06A

HEC-2, WATER SURFACE PROFILES.
W69-06787 04A

COMPUTERS
A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
W69-06764 07C

COMPUTOR MODELS
WATER QUALITY MANAGEMENT ENGINEERING-ECONOMIC FACTORS IN MUNICIPAL WASTE DISPOSAL,
W69-06505 05D

CONCRETE BLOCKS
THERMAL STRESS CONDITION OF EXPERIMENTAL LONG BLOCKS DURING CONSTRUCTION PERIOD OF THE BRATSK HYDROELECTRIC STATION DAM,
W69-06711 08F

CONCRETE CONSTRUCTION
THERMAL STRESS CONDITION OF EXPERIMENTAL LONG BLOCKS DURING CONSTRUCTION PERIOD OF THE BRATSK HYDROELECTRIC STATION DAM,
W69-06711 08F

CONCRETE TECHNOLOGY
THE MECHANISM OF WATER SEEPAGE THROUGH CONCRETE,
W69-06712 08F

CONCRETE TESTING
TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

RX CONCRETE,
W69-06678 08F

CONDEMNATION
WATERS AND WATER SUPPLY.
W69-06612 06E

NANTAHALA POWER AND LIGHT CO V SLOAN (FLOWAGE EASEMENTS).
W69-06620 06E

KANSAS CITY LIFE INS CO V UNITED STATES (IMPAIRMENT OF LAND VALUE DUE TO DAM CONSTRUCTION).
W69-06623 06E

CONDENSATION
BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
W69-06840 03A

CONDITIONAL PREDICTION
LEAST SQUARES, CONDITIONAL PREDICTIONS, AND ESTIMATOR PROPERTIES,
W69-06551 06A

CONFINED WATER
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

CONNATE WATER

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

CONSERVATION
CERTAIN GAME PRESERVES, AREAS, PROJECTS CONTROL.
W69-06635 06E

CONSOLIDATION
HORIZONTAL MOVEMENTS RELATED TO SUBSIDENCE,
W69-06692 08D

CONSTRUCTION
SEWERAGE DISTRICTS AND BOARDS.
W69-06633 06E

CONSUMER DEMAND FUNCTION
HOUSEHOLD PRODUCTION AND CONSUMER DEMAND FUNCTIONS,
W69-06566 06D

CONSUMPTIVE USE
PHOTOSYNTHESIS AND WATER USE BY SALTCEDAR,
W69-06771 03B

CONTAMINATION
TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH VOLTAGE INSULATORS.
W69-06708 08C

CONTRACT ADMINISTRATION
WATER SUPPLY DISTRICTS.
W69-06630 06E

CORPS OF ENGINEERS
KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

CORRELATION ANALYSIS
ESTIMATION OF RAINFALL IN SPARSELY GAUGED AREAS,
W69-06773 02B

CORROSION
ECONOMIC EFFECTS OF MINERAL CONTENT IN MUNICIPAL WATER SUPPLIES.
W69-06555 03A

CORROSION CONTROL
INNOVATIONS AND THE FUTURE OF CATHODIC PROTECTION,
W69-06677 08A

COSTS
A HEURISTIC AID FOR THE DESIGN OF SEWER NETWORKS,
W69-06498 05E

ECONOMIC EFFECTS OF MINERAL CONTENT IN MUNICIPAL WATER SUPPLIES.
W69-06555 03A

MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
W69-06559 03A

COST-BENEFIT ANALYSIS
IMPLICATIONS OF PROPERTY RIGHTS FOR GOVERNMENT INVESTMENT CHOICES,
W69-06548 06B

COTTON
WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
W69-06756 03F

COULTER COUNTER
APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
W69-06540 07B

CRIMINAL LAW
RUSSELL V STATE (ILLEGAL POSSESSION OF UNDERSIZED FISH).
W69-06589 06E

STATE V TAYLOR (FISH DYNAMITED IN PRIVATE POND).
W69-06605 06E

CROP PRODUCTION
EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
W69-06511 03F

THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

DROUGHT AND SOIL MOISTURE,
W69-06529 02G

CROP RESPONSE
WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
W69-06756 03F

THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

CROSS SECTION DATA
THE USE OF ERROR COMPONENTS MODELS IN COMBINING CROSS SECTION WITH TIME SERIES DATA,
W69-06552 06A

CRYSTALLINE ROCKS
SOME DETAILS ON THE CIRCULATION OF GROUNDWATER IN NON-KARSTIFIED FISSURED FORMATIONS IN CZECHOSLOVAKIA (FRENCH),
W69-06485 02F

CRYSTALLIZATION
THE METAMORPHISM OF WET SNOW,
W69-06477 02C

THE METAMORPHISM OF DRY SNOW AT A UNIFORM TEMPERATURE,
W69-06479 02C

CRYSTALLOGRAPHY
THE IMPORTANCE OF THE HYDROGEN ATOM ARRANGEMENT IN DETERMINING HOW ICE CAN DEFORM PLASTICALLY,
W69-06476 02C

CULTIVATION
DROUGHT AND SOIL MOISTURE,
W69-06529 02G

CULTURAL EUTROPHICATION
THE AGING OF LAKES,
W69-06535 02H

CULVERTS
CHRISTMAN V STATE (NEGLIGENCE IN CULVERT CONSTRUCTION).
W69-06624 06E

CURRENT AWARENESS
PERMUTED TITLE INDEX TO WATER RESEARCH JOURNALS, 1967.
W69-06539 10

CZECHOSLOVAKIA
SOME DETAILS ON THE CIRCULATION OF GROUNDWATER IN NON-KARSTIFIED FISSURED FORMATIONS IN CZECHOSLOVAKIA (FRENCH),
W69-06485 02F

DAIRY INDUSTRY
BARBER PURE MILK CO V GOLDIN (SURFACE DRAINAGE).
W69-06588 06E

DAM CONSTRUCTION
FRODERMAN V DIETZ (PRIVATE DAMS FOR FLOOD CONTROL).
W69-06617 06E

DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
W69-06675 05G

DAM DESIGN
THE POSSIBILITY OF USING A MOVABLE DAM THE 'FABRIDAM' AND ITS APPLICATION IN ARID REGIONS,
W69-06455 04A

DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
W69-06675 05G

DAM FOUNDATIONS
FOUNDATION PROBLEMS OF RUEDI DAM AND RESERVOIR,
W69-06673 08E

HIGH EARTHFILL DAM FOUNDATION GROUTING DESIGN AND CONSTRUCTION PROCEDURES,
W69-06674 08D

DAM SAFETY
SAFETY CONTROL OF PRIVATE DAMS,
W69-06433 04A

DAMAGES
BELL TEL CO V DRAVO CORP (UNDERWATER OBSTRUCTION TO NAVIGATION).
W69-06610 06E

EFFECT OF SUBSIDENCE ON WELL FIELDS,
W69-06763 04B

DAMS
THE POSSIBILITY OF USING A MOVABLE DAM THE 'FABRIDAM' AND ITS APPLICATION IN ARID REGIONS,
W69-06455 04A

A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
W69-06461 04A

ZOMBKOWSKI V WISCONSIN RIVER POWER CO (FLOODING DAMAGES CAUSED BY DAM CONSTRUCTION).
W69-06603 06E

IOWA-WISCONSIN BRIDGE CO V UNITED STATES (LIABILITY FOR RESERVOIR OPERATION).
W69-06604 06E

BURNQUIST V FISCHER (FLOWAGE EASEMENT APPURTENANT TO DAM).
W69-06615 06E

MANTAHALA POWER AND LIGHT CO V SLOAN (FLOWAGE EASEMENTS).
W69-06620 06E

CLEMENTS V TOWN OF CARROLLTON (DAM ACROSS DRAINAGE DITCH).
W69-06627 06E

HUGHES V KNIGHT (RIGHT TO UNOBSTRUCTED DRAINAGE OF SURFACE WATERS).
W69-06660 06E

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06670 06E

DATA COLLECTIONS
ESTIMATED WATER USE IN NEVADA, 1950-65,
W69-06446 06D

EXTENSIONS OF STREAMFLOW RECORDS IN UTAH,
W69-06447 02E

COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
W69-06733 06B

WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1966-SEPTEMBER 1967,
W69-06786 02H

CLIMATOLOGY STUDIES OF BAFFIN ISLAND, NORTHWEST TERRITORIES,
W69-06814 02B

RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
W69-06820 02F

DATA NEEDS
AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
W69-06770 04C

DATA STORAGE AND RETRIEVAL
A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
W69-06764 07C

DECISION MAKING
IMPLICATIONS OF PROPERTY RIGHTS FOR GOVERNMENT INVESTMENT CHOICES,
W69-06548 06B

DEDICATION
EARLE V MCCARTY (TITLE TO LAND BETWEEN SOUND AND DEDICATED ROAD).
W69-06646 06E

DELAWARE
DRAPER V MOSHIER (INTERFERENCE WITH DRAINAGE DITCH).
W69-06600 06E

WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF ENGINEERS IN DELAWARE.
W69-06783 09D

DELAWARE ESTUARY
PRELIMINARY REMOTE SENSING OF THE DELAWARE ESTUARY,
W69-06793 02L

DEMINERALIZATION
THE STATUS OF SEA WATER CONVERSION,
W69-06583 03A

DEPOSITION(SEDIMENTS)
A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
W69-06513 02J

DESALINATION
THE POTENTIAL CONTRIBUTION OF DESALTING TO FUTURE WATER SUPPLY IN TEXAS.
W69-06558 03A

MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
W69-06559 03A

DESALTED SEAWATER FOR AGRICULTURE IS IT ECONOMIC,
W69-06765 03F

DESALINATION PLANTS
OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
W69-06495 03A

DESALINATION PROCESSES
SUL-BISUL(T) ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W69-06836 03A

RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W69-06837 03A

DESERT PLANTS
TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
W69-06526 02D

DESIGN
PIPELINE PLANNING BY DYNAMIC COMPUTER PROGRAMMING,
W69-06493 06A

OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
W69-06495 03A

DESIGN CRITERIA
A SIMPLIFIED TECHNIQUE FOR WELL-FIELD DESIGN,
W69-06421 02F

500-KV AC SUBSTATION DESIGN CRITERIA--SUMMARY OF INDUSTRY PRACTICES,
W69-06686 08C

GEOLOGY, DESIGN, AND CONSTRUCTION OF DEEP WELLS IN SEDIMENTARY FOUNDATIONS,
W69-06759 02F

DEWATERING
A DESIGN METHOD FOR DEEP WELL DEWATERING INSTALLATIONS,
W69-06430 02F

DEWATERING SYSTEM DESIGN
A DESIGN METHOD FOR DEEP WELL DEWATERING INSTALLATIONS,
W69-06430 02F

DIFFERENTIAL EQUATIONS
NONRECURSIVE MODELS AS DISCRETE APPROXIMATIONS TO SYSTEMS OF STOCHASTIC DIFFERENTIAL EQUATIONS,
W69-06571 06A

DIFFUSION
THE HYDROLOGIC IMPORTANCE OF TRANSPIRATION CONTROL BY STOMATA,
W69-06520 02D

DIFFUSIVITY
SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD,
W69-06528 02G

DIGITAL COMPUTER
KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

DIGITAL COMPUTERS
A HEURISTIC AID FOR THE DESIGN OF SEWER NETWORKS,
W69-06498 05E

WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
W69-06499 05G

USE OF DIGITAL COMPUTERS IN DISTRIBUTION SYSTEM ANALYSES,
W69-06503 07C

DIKES
USE OF ASPHALTIC CONCRETE IN COASTAL AND CANAL CONSTRUCTION,
W69-06682 08F

DIPS
GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
W69-06681 07B

DIRECT CURRENT
CALCULATION OF BALANCED AND UNBALANCED FAULT CURRENTS IN AC-DC POWER SYSTEMS,
W69-06690 08C

SOME ASPECTS OF INSULATION CO-ORDINATION IN HVDC SYSTEMS,
W69-06707 08C

DISCHARGE WATER
SBARRA V ERIE RR (DRAINAGE OF SURFACE WATERS AND PRESCRIPTIVE RIGHTS).
W69-06591 06E

DISCHARGE(WATER)
INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO,
W69-06427 02E

RAU V WILDEN ACRES, INC (DIVERSION OF NATURAL FLOW BY ARTIFICIAL CHANNEL).
W69-06656 06E

RINZLER V FOLSOM (ARTIFICIAL INCREASE OF SURFACE RUNOFF).
W69-06657 06E

DISCRETE APPROXIMATION
NONRECURSIVE MODELS AS DISCRETE APPROXIMATIONS TO SYSTEMS OF STOCHASTIC DIFFERENTIAL EQUATIONS,
W69-06571 06A

DISCRIMINANT FUNCTION
LINEAR PROBABILITY FUNCTIONS AND DISCRIMINANT FUNCTIONS,
W69-06563 06A

DISPENSERS
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

DISPLACEMENT
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

DISTRIBUTED LAG ANALYSIS
LONG-RUN COEFFICIENTS AND DISTRIBUTED LAG ANALYSIS A REFORMULATION,
W69-06557 06A

DISTRIBUTION PATTERNS
LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
W69-06799 02J

DISTRICT OF COLUMBIA
UNITED STATES V GROEN (TITLE TO FILLED IN LAND BORDERING ON A RIVER).
W69-06608 06E

DIVERSION
RAU V WILDEN ACRES, INC (DIVERSION OF NATURAL FLOW BY ARTIFICIAL CHANNEL).
W69-06656 06E

DIVISIBILITY OF SERVITUDES

OHIO OIL CO V FERGUSON (MINERAL RIGHTS AND ROYALTIES).
W69-06594 06E

DOMESTIC WATER
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W69-06502 06D

DOWNSPOUTS
COX V MARTIN (DISCHARGE OF SURFACE WATER THROUGH A DOWNSPOUT).
W69-06596 06E

DRAINAGE
KANSAS CITY LIFE INS CO V UNITED STATES (IMPAIRMENT OF LAND VALUE DUE TO DAM CONSTRUCTION).
W69-06623 06E

PROCEEDINGS OF TILE DRAINAGE RESEARCH CONFERENCE,
W69-06795 04A

DRAINAGE ENGINEERING
A DESIGN METHOD FOR DEEP WELL DEWATERING INSTALLATIONS,
W69-06430 02F

DRAINAGE SYSTEMS
DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
W69-06512 02G

CANNON V CITY OF MACON (NATURAL DRAINAGE FLOW AND THE LOWER LAND PROPRIETOR).
W69-06595 06E

CHRISTMAN V STATE (NEGLIGENCE IN CULVERT CONSTRUCTION).
W69-06624 06E

SEWERAGE DISTRICTS AND BOARDS.
W69-06633 06E

NASSAU COUNTY V CHERRY VALLEY ESTATES (LANDOWNERS RIGHT TO PREVENT FLOW OF SURFACE WATER ONTO HIS PROPERTY).
W69-06653 06E

SEWERS AND DRAINS PRIVATE DRAINS.
W69-06661 06E

PROCEEDINGS OF TILE DRAINAGE RESEARCH CONFERENCE,
W69-06795 04A

DRAINAGE WATER
BARBER PURE MILK CO V GOLDIN (SURFACE DRAINAGE).
W69-06588 06E

COX V MARTIN (DISCHARGE OF SURFACE WATER THROUGH A DOWNSPOUT).
W69-06596 06E

POTEETE V CITY OF WATER VALLEY (ARTIFICIAL CONTROL OF SUBSURFACE DRAINAGE).
W69-06626 06E

DRAINAGE WELLS
A DESIGN METHOD FOR DEEP WELL DEWATERING INSTALLATIONS,
W69-06430 02F

DRAINS
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
W69-06512 02G

DRAWDOWN
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

DREDGING
TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMM'N (PIPELINES ACROSS NAVIGABLE CHANNELS).
W69-06587 06E

DRILLING
OHIO OIL CO V FERGUSON (MINERAL RIGHTS AND ROYALTIES).
W69-06594 06E

DROUGHT
THE ABNORMALLY DRY WEATHER OF 1961-1966 IN THE NORTHEASTERN UNITED STATES,
W69-06437 02B

DROUGHT PREDICTION
SOME REMARKS ON THE PREDICTABILITY OF DROUGHT AND RELATED CLIMATIC ANOMALIES,
W69-06439 02B

DROUGHTS
DROUGHT IN THE NORTHEASTERN UNITED STATES,
W69-06436 02B

FURTHER STUDIES OF DROUGHT OVER NORTHEASTERN UNITED STATES,
W69-06438 02B

SOME REMARKS ON THE PREDICTABILITY OF DROUGHT AND RELATED CLIMATIC ANOMALIES,
W69-06439 02B

EFFECTS OF THE DROUGHT ON WATER RESOURCES-SURFACE AND SUBSURFACE HYDROLOGY,
W69-06440 02B

SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
W69-06524 02G

DROUGHT AND SOIL MOISTURE,
W69-06529 02G

DURABILITY
ECONOMIC EFFECTS OF MINERAL CONTENT IN MUNICIPAL WATER SUPPLIES.
W69-06555 03A

DYE RELEASES
TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
W69-06774 07B

DYNAMIC PROGRAMMING
PIPELINE PLANNING BY DYNAMIC COMPUTER PROGRAMMING,
W69-06493 06A

DYNAMICS
THE USE OF ELECTRIC ANALOG MODELS IN HYDRODYNAMICAL STUDY OF THE ALSACE AQUIFERS (FRENCH),
W69-06806 02F

EARTH DAMS
CITY OF PORTSMOUTH V CULPEPPER (SUIT FOR DAMAGES RESULTING FROM OVERFLOW OF OBSTRUCTED CANAL).
W69-06602 06E

FOUNDATION PROBLEMS OF RUEDI DAM AND RESERVOIR,
W69-06673 08E

HIGH EARTHFILL DAM FOUNDATION GROUTING DESIGN AND CONSTRUCTION PROCEDURES,
W69-06674 08D

DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
W69-06675 05G

EARTHWORKS
NON-ENGINEERING ELEMENTS IN FACTORS OF SAFETY IN SOIL AND FOUNDATION ENGINEERING,
W69-06695 08D

EASEMENTS
GEORGE V STATE (OBSTRUCTION OF SUBSURFACE FLOW).
W69-06590 06E

FRODERMAN V DIETZ (PRIVATE DAMS FOR FLOOD CONTROL).
W69-06617 06E

MANTAHALA POWER AND LIGHT CO V SLOAN (FLOWAGE EASEMENTS).
W69-06620 06E

DAVIS V CITY OF ALEXANDRIA (PUBLIC USE OF LEVEE BANK AS ROADWAY).
W69-06645 06E

ECONOMIC DEVELOPMENT
WATER TRANSPORTATION-IMPACT ON ECONOMIC DEVELOPMENT,
W69-06730 06B

ECONOMIC FEASIBILITY
A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS PART 1,
W69-06556 03C

ECONOMIC JUSTIFICATION
ECONOMIC FRAMEWORK FOR SALINITY CONTROL PROJECTS,
W69-06490 05D

ECONOMICS
SLUDGE DISPOSAL ALTERNATIVES -- SOCIO-ECONOMIC CONSIDERATIONS,
W69-06492 05E

THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W69-06502 06D

DESALTED SEAWATER FOR AGRICULTURE IS IT ECONOMIC,
W69-06765 03F

ECOSYSTEMS
SIMULATION OF AN AQUATIC ECOSYSTEM,
W69-06536 02H

THE DESIRABILITY AND APPLICABILITY OF SIMULATING ECOSYSTEMS,
W69-06537 06A

EDUCATION
MANPOWER REQUIREMENTS FOR POLLUTION CONTROL AND WATER RESOURCES IN INDIANA AND A RELATED POLLUTION CONTROL TECHNOLOGY CURRICULUM,
W69-06507 05G

EGYPTO-ARABIAN DESERT
TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
W69-06526 02D

ELASTICITY OF SUBSTITUTION
THE CES PRODUCTION FUNCTION A DERIVATION,
W69-06720 06B

ESTIMATION OF RETURNS TO SCALE AND THE ELASTICITY OF SUBSTITUTION,

W69-06732 06B

ELECTRIC FLOOD MODEL
KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

ELECTRIC INSULATION
SOME ASPECTS OF INSULATION CO-ORDINATION IN HVDC SYSTEMS,
W69-06707 08C

ELECTRIC POWER
A SWING RELAY FOR THE EAST-WEST INTERTIE,
W69-06687 08C

ELECTRIC POWER PRODUCTION
ELECTRICAL FEATURES OF THE GRAND COULEE THIRD POWER PLANT,
W69-06684 08C

ELECTRIC RELAYS
A SWING RELAY FOR THE EAST-WEST INTERTIE,
W69-06687 08C

BROWN BOVERI DISTANCE PROTECTION SYSTEMS EMPLOYING CARRIER TRANSFER,
W69-06709 08C

DISTANCE PROTECTION OF HIGH-VOLTAGE LINES CONTAINING SERIES CAPACITORS,
W69-06710 08C

ELECTRICAL INSULATORS
TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH VOLTAGE INSULATORS.
W69-06708 08C

ELECTRICAL NETWORKS
CALCULATION OF BALANCED AND UNBALANCED FAULT CURRENTS IN AC-DC POWER SYSTEMS,
W69-06690 08C

EMBANKMENTS
CIRCULAR AND LOGARITHMIC SPIRAL SLIP SURFACES,
W69-06694 08D

EMINENT DOMAIN
XIDIS V CITY OF GULFPORT (USE OF SUBMERGED LANDS FOR PUBLIC PURPOSE).
W69-06621 06E

EMINENT DOMAIN.
W69-06642 06E

EMSCHER ASSOCIATION
WATER SUPPLY AND WASTEWATER TREATMENT PROBLEMS OF INDUSTRIAL AND TRADE ENTERPRISES,
W69-06723 05D

ENVIRONMENTAL EFFECTS
TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
W69-06526 02D

PROGRESS REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY, BEAUFORT, N. C., FISCAL YEAR 1968,
W69-06769 09C

EROSION
ERICKSON V GREUB (TITLE TO ACCRETION).
W69-06641 06E

USE OF TRACER TECHNIQUE IN SOIL EROSION RESEARCH,
W69-06704 04D

PREDICTION OF RAINSPLASH EROSION IN THE SEASONALLY WET TROPICS,
W69-06768 02J

COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
W69-06798 02L

DYNAMICS OF CHANNEL FLOW,
W69-06835 02E

EROSION CONTROL
A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
W69-06513 02J

ERICKSON V GREUB (TITLE TO ACCRETION).
W69-06641 06E

GRADED FURROWS FOR WATER EROSION CONTROL,
W69-06746 02J

ERROR COMPONENT
THE USE OF ERROR COMPONENTS MODELS IN COMBINING CROSS SECTION WITH TIME SERIES DATA,
W69-06552 06A

ESTIMATED PROPERTIES
LEAST SQUARES, CONDITIONAL PREDICTIONS, AND ESTIMATOR PROPERTIES,
W69-06551 06A

ESTIMATING
THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

ESTIMATING PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
W69-06522 02D

EVALUATION OF SOME PRACTICAL METHODS OF ESTIMATING EVAPOTRANSPIRATION IN ARID CLIMATES AT LOW LATITUDES,
W69-06530 02D

SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
W69-06567 06A

ESTIMATION
FIRST ORDER AUTO REGRESSION INFERENCE, ESTIMATION, AND PREDICTION,
W69-06550 06A

SPECIFICATION AND ESTIMATION OF COBB-DOUGLAS PRODUCTION FUNCTION MODELS,
W69-06560 06A

SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
W69-06567 06A

ESTIMATORS
ON THE RELATIVE SMALL-SAMPLE PROPERTIES OF SEVERAL STRUCTURAL-EQUATION ESTIMATORS,
W69-06734 06B

ESTUARIES
REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
W69-06767 09C

ESTUARINE ENVIRONMENT
REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
W69-06767 09C

ESTUARINE FISHERIES
REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
W69-06767 09C

EUTROPHICATION
THE AGING OF LAKES,
W69-06535 02H

APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
W69-06540 07B

EVAPORATION
ESTIMATING PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
W69-06522 02D

TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
W69-06526 02D

ON THE ESTIMATION OF EVAPORATION FROM A LAND SURFACE,
W69-06833 02D

BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
W69-06840 03A

EVAPORATION CONTROL
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

EVAPORATION PANS
ESTIMATING PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
W69-06522 02D

EVAPOTRANSPIRATION
EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
W69-06514 02G

ESTIMATING PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
W69-06522 02D

EVALUATION OF SOME PRACTICAL METHODS OF ESTIMATING EVAPOTRANSPIRATION IN ARID CLIMATES AT LOW LATITUDES,
W69-06530 02D

EVIDENCE
HAMMEL V CAMP RANGER, INC (PRESUMPTIONS REGARDING CONVEYANCE OF INLAND, NON-NAVIGABLE POND).
W69-06648 06E

EXPANSION
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

EXPANSIVE CLAYS
PREDICTION OF SWELLING PRESSURE OF CLAYS,
W69-06693 08D

EXPLOSIVES
STATE V TAYLOR (FISH DYNAMITED IN PRIVATE POND).
W69-06605 06E

EXPORT BASE CONCEPT
ECONOMIC ANALYSIS OF THE DEVELOPMENT POTENTIAL OF THE

COMMERCIAL FISHERIES INDUSTRY OF THE COASTAL PLAINS REGION,
W69-06554 06B

EXTRA HIGH VOLTAGE
500-KV AC SUBSTATION DESIGN CRITERIA--SUMMARY OF INDUSTRY PRACTICES,
W69-06686 08C

OPEN BREAKER PROTECTION OF EHV SYSTEMS,
W69-06688 08C

FAULTS(ELECTRICAL)
CALCULATION OF BALANCED AND UNBALANCED FAULT CURRENTS IN AC-DC POWER SYSTEMS,
W69-06690 08C

FEDERAL GOVERNMENT
CONSERVATION'S CHALLENGE TO STATE GOVERNMENTS,
W69-06586 06E

FEDERAL REPUBLIC OF GERMANY
WATER SUPPLY AND WASTEWATER TREATMENT PROBLEMS OF INDUSTRIAL AND TRADE ENTERPRISES,
W69-06723 05D

FINANCIAL CONSTRAINT
THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
W69-06547 05F

FIRE PROTECTION
ICE DEALERS BATHING WATER SUPPLY FOR RURAL FIRE PROTECTION.
W69-06631 06E

FIRST ORDER AUTOREGRESSION
FIRST ORDER AUTO REGRESSION INFERENCE, ESTIMATION, AND PREDICTION,
W69-06550 06A

FISH
A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
W69-06533 05C

ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

FISH AND WILDLIFE
ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

FISH CONSERVATION
STATE V TAYLOR (FISH DYNAMITED IN PRIVATE POND).
W69-06605 06E

FISH MANAGEMENT
RUSSELL V STATE (ILLEGAL POSSESSION OF UNDERSIZED FISH).
W69-06589 06E

FISHERIES
ECONOMIC ANALYSIS OF THE DEVELOPMENT POTENTIAL OF THE COMMERCIAL FISHERIES INDUSTRY OF THE COASTAL PLAINS REGION,
W69-06554 06B

FISSURES
ARTIFICIAL RECHARGE OF A FISSURED SANDSTONE AQUIFER, TANGIERS, MOROCCO (FRENCH),
W69-06487 04B

FISSURES(GEOLOGY)
GROUNDWATER IN FRACTURED VOLCANIC ROCKS IN SOUTHERN ARIZONA,
W69-06831 02F

FLASH DISTILLATION
OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
W69-06495 03A

FLASHOVER
TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH VOLTAGE INSULATORS.
W69-06708 08C

FLOOD CONTROL
RESERVOIR MANAGEMENT THE TRADEOFF BETWEEN LOW-FLOW REGULATION AND FLOOD CONTROL,
W69-06496 04A

FRODERMAN V DIETZ (PRIVATE DAMS FOR FLOOD CONTROL).
W69-06617 06E

FLOOD WALL BOARD.
W69-06647 06E

KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

FLOOD DAMAGE
FLOOD PLAIN INFORMATION, WILSON CREEK AND TRIBUTARIES, SPRINGFIELD, MISSOURI-PART 1.
W69-06467 04A

FLOOD PLAIN INFORMATION, ROCKY RIVER IN CITIES OF ROCKY RIVER AND LAKEWOOD, CUYAHOGA COUNTY, OHIO.
W69-06468 04A

FLOOD PLAIN INFORMATION, WALLA WALLA RIVER TRIBUTARIES IN THE VICINITY OF WALLA WALLA, WASHINGTON.
W69-06469 04A

FLOOD PLAIN INFORMATION, YAKIMA RIVER, BENTON COUNTY, WASHINGTON.
W69-06470 04A

FLOOD PLAIN INFORMATION, OMAHA METROPOLITAN REGION, NEBRASKA - VOLUME 1.
W69-06471 04A

FLOOD PLAIN INFORMATION, CEDAR RIVER, LINN COUNTY, IOWA.
W69-06472 04A

FLOOD PLAIN INFORMATION, GUAYANILLA RIVER, GUAYANILLA, PUERTO RICO.
W69-06473 04A

FONADELLAS V UNITED STATES (TEMPORARY TAKING OF PROPERTY FOR PUBLIC PURPOSE).
W69-06622 06E

FLOOD PLAIN INFORMATION, BOISE RIVER AND NORTHSIDE TRIBUTARIES, BOISE, IDAHO AND VICINITY.
W69-06823 04A

FLOOD PLAIN INFORMATION OF SPRING VALLEY CREEK, SAN DIEGO COUNTY, CALIFORNIA.
W69-06824 04A

FLOOD PLAIN INFORMATION OF SENECA LAKE, NEW YORK.
W69-06825 04A

FLOOD PLAIN INFORMATION, CAYUGA LAKE, NEW YORK.
W69-06826 04A

FLOOD PLAIN INFORMATION, CANANDAIGUA LAKE, NEW YORK.
W69-06827 04A

FLOOD ESTIMATE
A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
W69-06680 02E

FLOOD FORECASTING
A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
W69-06680 02E

FLOOD PEAKS
A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
W69-06680 02E

FLOOD PROBABILITY
A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
W69-06680 02E

FLOOD PROTECTION
KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

FLOOD WALLS
FLOOD WALL BOARD.
W69-06647 06E

FLOODING
ZOMBKOWSKI V WISCONSIN RIVER POWER CO (FLOODING DAMAGES CAUSED BY DAM CONSTRUCTION).
W69-06603 06E

FLOODS
FLOOD INUNDATION AND EFFECTS OF URBANIZATION IN METROPOLITAN CHARLOTTE, NORTH CAROLINA,
W69-06485 04C

FLOOD PLAIN INFORMATION, WILSON CREEK AND TRIBUTARIES, SPRINGFIELD, MISSOURI-PART 1.
W69-06467 04A

FLOOD PLAIN INFORMATION, ROCKY RIVER IN CITIES OF ROCKY RIVER AND LAKEWOOD, CUYAHOGA COUNTY, OHIO.
W69-06468 04A

FLOOD PLAIN INFORMATION, WALLA WALLA RIVER TRIBUTARIES IN THE VICINITY OF WALLA WALLA, WASHINGTON.
W69-06469 04A

FLOOD PLAIN INFORMATION, YAKIMA RIVER, BENTON COUNTY, WASHINGTON.
W69-06470 04A

FLOOD PLAIN INFORMATION, OMAHA METROPOLITAN REGION, NEBRASKA - VOLUME 1.
W69-06471 04A

FLOOD PLAIN INFORMATION, CEDAR RIVER, LINN COUNTY, IOWA.
W69-06472 04A

FLOOD PLAIN INFORMATION, GUAYANILLA RIVER, GUAYANILLA, PUERTO RICO.
W69-06473 04A

A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
W69-06680 02E

FLOOD PLAIN INFORMATION, BOISE RIVER AND NORTHSIDE TRIBUTARIES, BOISE, IDAHO AND VICINITY.
W69-06823 04A

FLOOD PLAIN INFORMATION OF SPRING VALLEY CREEK, SAN DIEGO COUNTY, CALIFORNIA.
W69-06824 04A

FLOOD PLAIN INFORMATION OF SENECA LAKE, NEW YORK.
W69-06825 04A

FLOOD PLAIN INFORMATION, CAYUGA LAKE, NEW YORK.
W69-06826 04A

FLOOD PLAIN INFORMATION, CANANDAIGUA LAKE, NEW YORK.
W69-06827 04A

FLORIDA
CARNASION V PAUL (RIGHT OF A COUNTY TO TAX TIDELAND PROPERTY).
W69-06644 06E

EARLE V MCCARTY (TITLE TO LAND BETWEEN SOUND AND DEDICATED ROAD).
W69-06646 06E

FLORIDA OCEANOGRAPHY
REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
W69-06767 09C

FLOW
THE MECHANICAL PROPERTIES OF SINGLE CRYSTALS OF ICE AT LOW TEMPERATURES,
W69-06474 02C

DEFORMATION OF POLYCRYSTALLINE ICE UNDER COMBINED UNIAXIAL AND HYDROSTATIC PRESSURE,
W69-06475 02C

FLOW PROFILES
HEC-2, WATER SURFACE PROFILES.
W69-06787 04A

FOLIAR APPLICATION
TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

FORECASTING
SOME REMARKS ON THE PREDICTABILITY OF DROUGHT AND RELATED CLIMATIC ANOMALIES,
W69-06439 02B

FIRST ORDER AUTO REGRESSION INFERENCE, ESTIMATION, AND PREDICTION,
W69-06550 06A

FORECASTING URBAN WATER DEMANDS IN DEVELOPING COUNTRIES,
W69-06727 06D

ON THE ESTIMATION OF EVAPORATION FROM A LAND SURFACE,
W69-06833 02D

FORMULAE
ESTIMATING PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
W69-06522 02D

FOURIER ANALYSIS
AN HARMONIC ANALYSIS OF NONSTATIONARY MULTIVARIATE ECONOMIC PROCESSES,
W69-06553 06A

FRANCIS TURBINES
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
W69-06698 08C

FREEZE THAW TESTS
TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

FREEZING
TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

FREQUENCY ANALYSIS
FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL, U.S. COASTAL REGION, GULF OF MEXICO,
W69-06797 02B

FRESH WATER
GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

FRESHETS
RINZLER V FOLSOM (ARTIFICIAL INCREASE OF SURFACE RUNOFF).
W69-06657 06E

FURROW SYSTEMS
GRADED FURROWS FOR WATER EROSION CONTROL,
W69-06746 02J

GAMMA RAYS
EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
W69-06514 02G

GAUSSIAN MARKOV RESIDUALS
SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS,
W69-06569 06A

GENERAL WATER SCHEMES
THE GENERAL WATER SCHEME - AN ESSENTIAL BASIS FOR THE MOST RATIONAL USE OF WATER RESOURCES,
W69-06724 06B

GEOCHEMISTRY
POTASSIUM, ILLITE AND THE OCEAN,
W69-06506 02K

GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

GEOMORPHOLOGY
A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
W69-06513 02J

GEORGIA
CANNON V CITY OF MACON (NATURAL DRAINAGE FLOW AND THE LOWER LAND PROPRIETOR).
W69-06595 06E

COX V MARTIN (DISCHARGE OF SURFACE WATER THROUGH A DOWNSPOUT).
W69-06596 06E

RINZLER V FOLSOM (ARTIFICIAL INCREASE OF SURFACE RUNOFF).
W69-06657 06E

GLACIERS
THE ANNUAL HEAT ENERGY TRANSFER ABOVE AND INSIDE ANTARCTICA BLUE ICE,
W69-06480 02C

RELATIONS BETWEEN GLACIER RUNOFF AND METEOROLOGICAL FACTORS OBSERVED ON AND OUTSIDE THE GLACIER,
W69-06481 02C

A TEMPERATURE PROFILE THROUGH THE MEIGHEN ICE CAP, ARCTIC CANADA,
W69-06482 02C

RECENT HISTORY OF GULKANA AND COLLEGE GLACIERS, CENTRAL ALASKA RANGE, ALASKA,
W69-06808 02C

GOLODNAIA STEPPE(USSR)
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W69-06716 03F

GOVERNMENT SUPPORTS
CONSTRUCTION AND MANAGEMENT OF RIVER VALLEY PROJECTS IN INDIA,
W69-06457 04A

GRADIENT METHOD
MAXIMIZATION BY QUADRATIC HILL-CLIMBING,
W69-06564 06A

GRADING
GRADED FURROWS FOR WATER EROSION CONTROL,
W69-06746 02J

GRAND COULEE POWERPLANT(WASH)
ELECTRICAL FEATURES OF THE GRAND COULEE THIRD POWER PLANT,
W69-06684 08C

GRAVEL MULCHES
CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
W69-06796 03F

GRAVITY STUDIES
GROUND WATER, GRAVITY AND RIFT VALLEYS IN MALAWI,
W69-06431 02F

GRAY HYDROCAL HYGROMETER
TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
W69-06516 02G

GREAT LAKES
GREAT LAKES COMPACT (AGREEMENT FOR EFFICIENT MANAGEMENT OF THE GREAT LAKES BASIN).
W69-06616 06E

GREAT LAKES COMMISSION
GREAT LAKES COMPACT (AGREEMENT FOR EFFICIENT MANAGEMENT OF THE GREAT LAKES BASIN).
W69-06616 06E

GREAT LAKES COMPACT
GREAT LAKES COMPACT (AGREEMENT FOR EFFICIENT MANAGEMENT OF THE GREAT LAKES BASIN).
W69-06616 06E

GROUND WATER
CONTROL OF SEA-WATER INTRUSION IN A GROUND-WATER AQUIFER,
W69-06422 02F

GROUNDWATER
A SIMPLIFIED TECHNIQUE FOR WELL-FIELD DESIGN,
W69-06421 02F

SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
W69-06424 06A

EFFECTS OF MINE DRAINAGE ON GROUND WATER,
W69-06425 05C

MICROBIAL PROBLEMS IN GROUNDWATER,
W69-06426 05C

WATER-RESOURCES APPRAISAL OF THE LOWER MOAPA-LAKE MEAD AREA, CLARK COUNTY, NEVADA,
W69-06435 02F

SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

GEOLOGY AND GROUND-WATER RESOURCES OF BURLINGTON COUNTY, NEW JERSEY,
W69-06449 02F

GEOLOGY AND GROUND-WATER RESOURCES OF THE RAHWAY AREA, NEW JERSEY,
W69-06450 02F

WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
W69-06451 02E

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

GROUND WATER FAVORABILITY MAP OF THE OTTAUQUECHEE-SAXTONS RIVER BASIN, VERMONT,
W69-06463 02F

GROUND WATER FAVORABILITY MAP OF THE WEST-DEERFIELD RIVER BASIN, VERMONT,
W69-06464 02F

GROUND WATER FAVORABILITY MAP OF THE WELLS-OMPOMPANOOSUC RIVER BASIN, VERMONT,
W69-06465 02F

GROUND WATER FAVORABILITY MAP OF THE WHITE RIVER BASIN, VERMONT,
W69-06466 02F

GEOLOGY AND HYDROLOGY OF CLAY COUNTY SOUTH DAKOTA-PART 1, GEOLOGY, AND PART 2, WATER RESOURCES,
W69-06486 02F

PRINCIPLES OF CHOOSING EXPERIMENTAL PLOTS FOR WATER BALANCE STUDIES IN IRRIGATION REGIONS OF THE ARID ZONE,
W69-06523 02G

ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

ROLE OF GROUND WATER CONTAMINATION IN WATER MANAGMENT,
W69-06762 05G

A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
W69-06764 07C

THE GROUNDWATER PROVINCES OF IRAN,
W69-06772 04B

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
W69-06815 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
W69-06816 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
W69-06817 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
W69-06818 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
W69-06819 02F

GROUNDWATER IN FRACTURED VOLCANIC ROCKS IN SOUTHERN ARIZONA,
W69-06831 02F

GROUNDWATER BARRIERS
KANSAS CITY LIFE INS CO V UNITED STATES (IMPAIRMENT OF LAND VALUE DUE TO DAM CONSTRUCTION).
W69-06623 06E

GROUNDWATER BASINS
GEOLOGY, DESIGN, AND CONSTRUCTION OF DEEP WELLS IN SEDIMENTARY FOUNDATIONS,
W69-06759 02F

GROUNDWATER CONTAMINATION
MICROBIAL PROBLEMS IN GROUNDWATER,
W69-06426 05C

GROUNDWATER MANAGEMENT
SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
W69-06424 06A

GROUNDWATER MINING
ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
W69-06509 02F

GROUNDWATER MOVEMENT
SOME DETAILS ON THE CIRCULATION OF GROUNDWATER IN NON-KARSTIFIED FISSURED FORMATIONS IN CZECHOSLOVAKIA (FRENCH),
W69-06485 02F

TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
W69-06774 07B

GROUNDWATER RECHARGE
A CONTRIBUTION TO THE STUDY OF GROUNDWATER INTAKE RECHARGE IN KARST,
W69-06484 02F

GROUND-WATER POLLUTION
EFFECTS OF MINE DRAINAGE ON GROUND WATER,
W69-06425 05C

GROUTING
HIGH EARTHFILL DAM FOUNDATION GROUTING DESIGN AND CONSTRUCTION PROCEDURES,
W69-06674 08D

GROWTH RATES
A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
W69-06533 05C

GROWTH STAGES
EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
W69-06511 03F

GULF COASTAL PLAIN
FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL, U.S. COASTAL REGION, GULF OF MEXICO,
W69-06797 02B

GYROSCOPIC EFFECTS
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
W69-06698 08C

HARBORS
XIDIS V CITY OF GULFPORT (USE OF SUBMERGED LANDS FOR PUBLIC PURPOSE).
W69-06621 06E

HARMONICS
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
W69-06698 08C

HEAT BUDGET
RELATIONS BETWEEN GLACIER RUNOFF AND METEOROLOGICAL FACTORS OBSERVED ON AND OUTSIDE THE GLACIER,
W69-06481 02C

HEAT TRANSFER
THE ANNUAL HEAT ENERGY TRANSFER ABOVE AND INSIDE ANTARCTICA BLUE ICE,
W69-06480 02C

HERBICIDES
ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

HIGH VOLTAGE
SOME ASPECTS OF INSULATION CO-ORDINATION IN HVDC SYSTEMS,
W69-06707 08C

HIGHWAY EFFECTS
GIBSON V STATE (CONSTRUCTION AND MAINTENANCE OF SEWERS).
W69-06607 06E

HISTORY
A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
W69-06461 04A

HORIZONTAL MOVEMENT
HORIZONTAL MOVEMENTS RELATED TO SUBSIDENCE,
W69-06692 08D

HOUSEHOLD PRODUCTION
HOUSEHOLD PRODUCTION AND CONSUMER DEMAND FUNCTIONS,
W69-06566 06D

HOUTHAKKER'S CAPACITY METHOD
A PARAMETRIC SIMPLICAL FORMULATION OF HOUTHAKKER'S CAPACITY METHOD,
W69-06568 06A

HUNGARY
TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
W69-06774 07B

HYDRAULIC CONDUCTIVITY
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

HYDRAULIC TRANSIENTS
PRESSURE TRANSIENTS IN HYDRAULIC PIPELINES,
W69-06700 08A

HYDRAULIC TURBINES
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
W69-06698 08C

HYDRODAT SYSTEM
A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
W69-06764 07C

HYDROELECTRIC PLANTS
ELECTRICAL FEATURES OF THE GRAND COULEE THIRD POWER PLANT,
W69-06684 08C

HYDROGEOLOGY
GROUND WATER, GRAVITY AND RIFT VALLEYS IN MALAWI,
W69-06431 02F

PRINCIPLES OF CHOOSING EXPERIMENTAL PLOTS FOR WATER BALANCE STUDIES IN IRRIGATION REGIONS OF THE ARID ZONE,
W69-06523 02G

GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
W69-06758 02F

THE GROUNDWATER PROVINCES OF IRAN,
W69-06772 04B

HYDROLOGIC BUDGET
RELATIONS BETWEEN GLACIER RUNOFF AND METEOROLOGICAL FACTORS OBSERVED ON AND OUTSIDE THE GLACIER,
W69-06481 02C

HYDROLOGIC CYCLE
HYDROLOGIC CYCLE AS A CLOSED SYSTEM,
W69-06442 02A

HYDROLOGIC DATA
PRINCIPLES OF CHOOSING EXPERIMENTAL PLOTS FOR WATER BALANCE STUDIES IN IRRIGATION REGIONS OF THE ARID ZONE,
W69-06523 02G

A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
W69-06764 07C

REGIONAL HYDROLOGIC AREA STUDY AS AN ANALYSIS TOOL IN WEATHER MODIFICATION,
W69-06805 02A

HYDROLOGIC PROPERTIES
A CONTRIBUTION TO THE STUDY OF GROUNDWATER INTAKE RECHARGE IN KARST,
W69-06484 02F

ARTIFICIAL RECHARGE OF A FISSURED SANDSTONE AQUIFER, TANGIERS, MOROCCO (FRENCH),
W69-06487 04B

HYDROLOGICAL TIME SERIES
EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
W69-06789 02A

HYDROSTATIC PRESSURE
DEFORMATION OF POLYCRYSTALLINE ICE UNDER COMBINED UNIAXIAL AND HYDROSTATIC PRESSURE,
W69-06475 02C

HYGROMETRY
TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
W69-06516 02G

ICE DEALERS
ICE DEALERS BATHING WATER SUPPLY FOR RURAL FIRE PROTECTION.
W69-06631 06E

IDAHO
INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO,
W69-06427 02E

FLOOD PLAIN INFORMATION, BOISE RIVER AND NORTHSIDE TRIBUTARIES, BOISE, IDAHO AND VICINITY.
W69-06823 04A

IGNEOUS ROCKS
GROUNDWATER IN FRACTURED VOLCANIC ROCKS IN SOUTHERN ARIZONA,
W69-06831 02F

ILLINOIS
SAVOIE V TOWN OF BOURBONNAIS (PRESCRIPTIVE RIGHTS).
W69-06655 06E

ILLITE
POTASSIUM, ILLITE AND THE OCEAN,
W69-06506 02K

IMPACT(RAINFALL)
PREDICTION OF RAINSPLASH EROSION IN THE SEASONALLY WET TROPICS,
W69-06768 02J

IMPERFECT COMPETITION
OPTIMALITY OF IMPERFECTLY COMPETITIVE RESOURCE ALLOCATION,
W69-06722 06C

IMPERVIOUS SOILS
THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
W69-06758 02F

IMPOUNDED WATERS
IOWA-WISCONSIN BRIDGE CO V UNITED STATES (LIABILITY FOR RESERVOIR OPERATION).
W69-06604 06E

INDIA
CONSTRUCTION AND MANAGEMENT OF RIVER VALLEY PROJECTS IN INDIA,
W69-06457 04A

A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
W69-06461 04A

SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
W69-06524 02G

INDIANA
FRODERMAN V DIETZ (PRIVATE DAMS FOR FLOOD CONTROL).
W69-06617 06E

STATE V KIVETT (SUIT TO ENJOIN PRIVATE MINING OF STATE-OWNED RIVER BEDS).
W69-06629 06E

INDUSTRIAL CHEMICAL SPILLS
OIL AND HAZARDOUS MATERIALS-EMERGENCY PROCEDURES IN THE WATER ENVIRONMENT.
W69-06791 05G

INDUSTRIAL PRODUCTION
WATER TRANSPORTATION-IMPACT ON ECONOMIC DEVELOPMENT,
W69-06730 06B

WATER POLLUTION CONTROL,
W69-06731 05G

INDUSTRIAL WASTE CONFERENCE
22 ND INDUSTRIAL WASTE CONFERENCE, 1967, PART ONE,
W69-06821 05D

INDUSTRIAL WASTES
22 ND INDUSTRIAL WASTE CONFERENCE, 1967, PART ONE,
W69-06821 05D

INFERENCE
FIRST ORDER AUTO REGRESSION INFERENCE, ESTIMATION, AND PREDICTION,
W69-06550 06A

INFILTRATION
A CONTRIBUTION TO THE STUDY OF GROUNDWATER INTAKE RECHARGE IN KARST,
W69-06484 02F

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
W69-06796 03F

INFILTRATON RATE
EXTENDED TECHNIQUES OF CALCULATION OF SOIL-WATER MOVEMENT, WITH SOME PHYSICAL CONSEQUENCES,
W69-06714 02G

INFLOW
INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO,
W69-06427 02E

INFORMATION RETRIEVAL
A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
W69-06764 07C

INFORMATION THEORY
SPECIES DIVERSITY AND COMMUNITY STRUCTURE IN LACUSTRINE PHYTOPLANKTON,
W69-06542 02H

INFRARED RADIATION
PRELIMINARY REMOTE SENSING OF THE DELAWARE ESTUARY,
W69-06793 02L

INJUNCTIONS(MANDATORY)
COLEMAN V SCHAEFFER (OBSTRUCTION TO NAVIGABLE STREAM).
W69-06584 06E

CLEMENTS V TOWN OF CARROLLTON (DAM ACROSS DRAINAGE DITCH).
W69-06627 06E

INPUT-OUTPUT ANALYSIS
INTERREGIONAL PRODUCTION AND WATER RESOURCE DEPENDENCIES AMONG THE WESTERN STATES,
W69-06721 06B

INSTITUTIONS

SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
W69-06725 06B

INSTRUMENTATION
A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

MEASUREMENT OF ROTATING MACHINERY VIBRATION AND FACTORS AFFECTING INSTRUMENT ACCURACY,
W69-06702 07B

A SYSTEM FOR MAKING REMOTE AND UNDISTURBED MEASUREMENTS OF SNOW SETTLEMENT AND TEMPERATURES,
W69-06803 02C

INTACT PLANTS
A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

INTERCONNECTED SYSTEMS
A SWING RELAY FOR THE EAST-WEST INTERTIE,
W69-06687 08C

INTERMOLECULAR POTENTIALS
INTERMOLECULAR FORCES AND THE LIQUID STATE,
W69-06838 01A

INTERNATIONAL ATOMIC ENERGY AGENCY
THE ROLE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IN THE DEVELOPMENT, USE AND CONTROL OF WATER RESOURCES.
W69-06456 03A

INTERNATIONAL COMMISSIONS
GREAT LAKES COMPACT (AGREEMENT FOR EFFICIENT MANAGEMENT OF THE GREAT LAKES BASIN).
W69-06616 06E

INTERNATIONAL LAW
BENEFICIAL USES OF WATERS OF INTERNATIONAL RIVERS INTERNATIONAL LAW AND PRACTICE,
W69-06458 06E

INTERNATIONAL RIVERS
BENEFICIAL USES OF WATERS OF INTERNATIONAL RIVERS INTERNATIONAL LAW AND PRACTICE,
W69-06458 06E

INTERREGIONAL PRODUCTION
INTERREGIONAL PRODUCTION AND WATER RESOURCE DEPENDENCIES AMONG THE WESTERN STATES,
W69-06721 06B

INTERRUPTER SWITCHES
SHUNT CAPACITOR ENERGIZATION WITH VACUUM INTERRUPTERS--A POSSIBLE SOURCE OF OVERVOLTAGE,
W69-06689 08C

INTERRUPTERS
SHUNT CAPACITOR ENERGIZATION WITH VACUUM INTERRUPTERS--A POSSIBLE SOURCE OF OVERVOLTAGE,
W69-06689 08C

INTERSTATE COMPACTS
GREAT LAKES COMPACT (AGREEMENT FOR EFFICIENT MANAGEMENT OF THE GREAT LAKES BASIN).
W69-06616 06E

INTERTIES
A SWING RELAY FOR THE EAST-WEST INTERTIE,
W69-06687 08C

INTER-INDUSTRY SECTORS
SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
W69-06725 06B

INVESTMENT
ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

ION EXCHANGE
SUL-BISUL(T) ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W69-06836 03A

IOWA
FLOOD PLAIN INFORMATION, CEDAR RIVER, LINN COUNTY, IOWA.
W69-06472 04A

IRAN
THE POSSIBILITY OF USING A MOVABLE DAM THE 'FABRIDAM' AND ITS APPLICATION IN ARID REGIONS,
W69-06455 04A

THE GROUNDWATER PROVINCES OF IRAN,
W69-06772 04B

IRRIGATED LAND
SALT BALANCE AND SALT TRANSPORT PROCESSES IN IRRIGATED SOILS,
W69-06717 03F

IRRIGATION
AGRICULTURE USE OF WATER IN TAIWAN, REPUBLIC OF CHINA,
W69-06460 03F

A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
W69-06461 04A

IRRIGATION EFFECTS
WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
W69-06499 05G

THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

IRRIGATION EFFICIENCY
MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
W69-06454 03F

EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
W69-06511 03F

IRRIGATION OPERATION AND MAINTENANCE
IRRIGATION WATER SYSTEM--ISRAEL'S NATIONAL WATER GRID,
W69-06459 03F

IRRIGATION PRACTICES
MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
W69-06454 03F

IRRIGATION PROGRAMS
CONSTRUCTION AND MANAGEMENT OF RIVER VALLEY PROJECTS IN INDIA,
W69-06457 04A

IRRIGATION WELLS
THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
W69-06758 02F

ISRAEL
MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
W69-06454 03F

IRRIGATION WATER SYSTEM--ISRAEL'S NATIONAL WATER GRID,
W69-06459 03F

GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

ITERATIVE ANALYSIS
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

JORDON RIFT VALLEY
THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

JURISDICTION
WHITE OAK BOROUGH AUTH V PENN PUB U COMM'N (AQUISITION OF PUBLIC WATER FACILITIES).
W69-06601 06E

JURISDICTION OVER WATERS.
W69-06634 06E

KANSAS RIVER BASIN
KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

KARST
CONCEPTUAL MODELS FOR CARBONATE AQUIFERS,
W69-06423 02F

A CONTRIBUTION TO THE STUDY OF GROUNDWATER INTAKE RECHARGE IN KARST,
W69-06484 02F

TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
W69-06774 07B

KENTUCKY
BALL CREEK COAL CO V NAPIER (MEANDERS AS A BOUNDARY).
W69-06614 06E

ADKINS V HUGHES (BOUNDARY DISPUTE DUE TO AVULSION).
W69-06658 06E

LAKE BASINS
GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

LAKE ERIE
COLEMAN V SCHAEFFER (OBSTRUCTION TO NAVIGABLE STREAM).
W69-06584 06E

LAKE TIBERIAS BASIN
GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

LAKES
THE AGING OF LAKES,
W69-06535 02H

ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

SPECIES DIVERSITY AND COMMUNITY STRUCTURE IN LACUSTRINE PHYTOPLANKTON,
W69-06542 02H

LAND FORMING
A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
W69-06513 02J

LAND MANAGEMENT
CERTAIN GAME PRESERVES, AREAS, PROJECTS CONTROL.
W69-06635 06E

LAND RECLAMATION
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W69-06716 03F

LAND TENURE
BINGENHEIMER V DIAMOND IRON MINING CO (DEFINITION OF NAVIGABLE WATER TO DETERMINE OWNERSHIP OF BEDS).
W69-06609 06E

FABLE V MCCARTY (TITLE TO LAND BETWEEN SOUND AND DEDICATED ROAD).
W69-06646 06E

HAMMEL V CAMP RANGER, INC (PRESUMPTIONS REGARDING CONVEYANCE OF INLAND, NON-NAVIGABLE POND).
W69-06648 06E

LANDFILLS
STATE V CITY OF CLEVELAND (RIGHT OF ACCESS TO NAVIGABLE WATERS).
W69-06619 06E

UNITED STATES V TURNER (OWNERSHIP OF BEDS UNDER SHALLOW WATERS).
W69-06628 06E

SKALITSKY V CONSOL BADGER CO-OPERATIVE (OWNERSHIP OF FILLED POND BED).
W69-06650 06E

LAS VEGAS VALLEY(NEV)
RECLAIMED WASTE WATER IN LAS VEGAS VALLEY,
W69-06832 05D

LATITUDINAL STUDIES
EVALUATION OF SOME PRACTICAL METHODS OF ESTIMATING EVAPOTRANSPIRATION IN ARID CLIMATES AT LOW LATITUDES,
W69-06530 02D

LEACHING
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W69-06716 03F

SALT BALANCE AND SALT TRANSPORT PROCESSES IN IRRIGATED SOILS,
W69-06717 03F

LEAKAGE
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

LEAST SQUARES METHOD
LEAST SQUARES, CONDITIONAL PREDICTIONS, AND ESTIMATOR PROPERTIES,
W69-06551 06A

LEAVES
THE HYDROLOGIC IMPORTANCE OF TRANSPIRATION CONTROL BY STOMATA,
W69-06520 02D

A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

LECTURE
HYDROLOGIC CYCLE AS A CLOSED SYSTEM,
W69-06442 02A

LEGAL ASPECTS
LEGAL ALTERNATIVES,
W69-06579 06E

LEGISLATION
THE LEGISLATIVE POINT OF VIEW,
W69-06580 06E

STATE V TAYLOR (FISH DYNAMITED IN PRIVATE POND).
W69-06605 06E

WATERS AND WATER SUPPLY.
W69-06612 06E

EMINENT DOMAIN.
W69-06642 06E

SEWERS AND DRAINS PRIVATE DRAINS.
W69-06661 06E

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06662 06E

W69-06663 06E

GENERAL PROVISIONS, REGULATING TO RIVERS AND STREAMS.
W69-06664 06E

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06665 06E

W69-06666 06E

W69-06667 06E

W69-06668 06E

W69-06669 06E

W69-06670 06E

W69-06671 06E

LEVEES
DAVIS V CITY OF ALEXANDRIA (PUBLIC USE OF LEVEE BANK AS ROADWAY).
W69-06645 06E

USE OF ASPHALTIC CONCRETE IN COASTAL AND CANAL CONSTRUCTION,
W69-06682 08F

LIFESPANS
A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
W69-06533 05C

LIGHTNING ARRESTERS
SOME ASPECTS OF INSULATION CO-ORDINATION IN HVDC SYSTEMS,
W69-06707 08C

LIGHTNING PROTECTION
OPEN BREAKER PROTECTION OF EHV SYSTEMS,
W69-06688 08C

LIMESTONES
ARTIFICIAL RECHARGE TO THE EDWARDS LIMESTONE AQUIFER IN SOUTH TEXAS,
W69-06483 04B

LINEAR PROBABILITY FUNCTION
LINEAR PROBABILITY FUNCTIONS AND DISCRIMINANT FUNCTIONS,
W69-06563 06A

LINEAR PROGRAMMING
RESERVOIR MANAGEMENT THE TRADEOFF BETWEEN LOW-FLOW REGULATION AND FLOOD CONTROL,
W69-06496 04A

THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
W69-06547 05F

LIQUID STATE
INTERMOLECULAR FORCES AND THE LIQUID STATE,
W69-06838 01A

LIQUIDS
INTERMOLECULAR FORCES AND THE LIQUID STATE,
W69-06838 01A

BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
W69-06840 03A

LOCAL GOVERNMENTS
POTEETE V CITY OF WATER VALLEY (ARTIFICIAL CONTROL OF SUBSURFACE DRAINAGE).
W69-06626 06E

LONG-RUN COEFFICIENTS
LONG-RUN COEFFICIENTS AND DISTRIBUTED LAG ANALYSIS A REFORMULATION,
W69-06557 06A

LONG-TERM PLANNING
SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
W69-06424 06A

REGIONAL PLANNING FOR WATER DEVELOPMENT IN THE WESTERN UNITED STATES - THE RELEVANCE OF AMERICAN EXPERIENCE FOR OTHER NATIONS,
W69-06726 06B

LONG-WAVE RADIATION
THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

LOUISIANA

TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMM'N (PIPELINES ACROSS NAVIGABLE CHANNELS).
W69-06587 06E

OHIO OIL CO V FERGUSON (MINERAL RIGHTS AND ROYALTIES).
W69-06594 06E

CALIFORNIA CO V PRICE (OWNERSHIP OF NAVIGABLE WATER BED).
W69-06613 06E

HAYNES V SMITH (PRIVATE COMMERCIAL VENTURES ON PUBLIC WATERS).
W69-06643 06E

DAVIS V CITY OF ALEXANDRIA (PUBLIC USE OF LEVEE BANK AS ROADWAY).
W69-06645 06E

RAINFALL-RUNOFF RELATIONS FOR SOUTHEASTERN LOUISIANA AND SOUTHWESTERN MISSISSIPPI,
W69-06829 02A

LOW-FLOW AUGMENTATION
RESERVOIR MANAGEMENT THE TRADEOFF BETWEEN LOW-FLOW REGULATION AND FLOOD CONTROL,
W69-06496 04A

MAGNESIUM COMPOUNDS
RECOVERY OF SALTS FROM SALINE WATER VIA SOLVENT EXTRACTION (FINAL REPORT),
W69-06839 03A

MAINE
SEWERS AND DRAINS PRIVATE DRAINS.
W69-06661 06E

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06662 06E

W69-06663 06E

GENERAL PROVISIONS, REGULATING TO RIVERS AND STREAMS.
W69-06664 06E

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06665 06E

W69-06666 06E

W69-06667 06E

W69-06668 06E

W69-06669 06E

W69-06670 06E

W69-06671 06E

MANPOWER
MANPOWER REQUIREMENTS FOR POLLUTION CONTROL AND WATER RESOURCES IN INDIANA AND A RELATED POLLUTION CONTROL TECHNOLOGY CURRICULUM,
W69-06507 05G

MAPPING
GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
W69-06681 07B

POTENTIAL OF RADAR REMOTE SENSORS AS TOOLS IN RECONNAISSANCE GEOMORPHIC, VEGETATION AND SOIL MAPPING,
W69-06718 07B

MARBURG LECTURE
SOIL AS AN ENGINEERING MATERIAL,
W69-06699 08D

MARINAS
HAYNES V SMITH (PRIVATE COMMERCIAL VENTURES ON PUBLIC WATERS).
W69-06643 06E

MARKOV PROCESSES
SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS,
W69-06569 06A

EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
W69-06789 02A

RANDOM PROCESSES AND LITHOLOGIC TRANSITIONS,
W69-06807 02J

MARYLAND
HANCOCK V STULL (INTERFERENCE WITH NATURAL DRAINAGE OF SURFACE WATER).
W69-06652 06E

CHESAPEAKE BAY CASE STUDY.
W69-06794 06B

MASS CONCRETE
THERMAL STRESS CONDITION OF EXPERIMENTAL LONG BLOCKS DURING CONSTRUCTION PERIOD OF THE BRATSK HYDROELECTRIC STATION DAM,
W69-06711 08F

MASSACHUSETTS
POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
W69-06802 05B

MATHEMATICAL MODELS
STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
W69-06500 05B

COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
W69-06733 06B

STREAMFLOW RECORD LENGTH FOR MODELLING CATCHMENT DYNAMICS,
W69-06781 02E

HEC-2, WATER SURFACE PROFILES.
W69-06787 04A

HEC-3, RESERVIOR SYSTEM ANALYSIS.
W69-06788 04A

ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
W69-06813 02F

QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
W69-06822 02A

IMPROVED TECHNIQUES FOR ESTIMATING RUNOFF WITH BRIEF RECORDS,
W69-06830 02E

MATHEMATICAL STUDIES
HYDROLOGIC CYCLE AS A CLOSED SYSTEM,
W69-06442 02A

MAXIMIZATION
MAXIMIZATION BY QUADRATIC HILL-CLIMBING,
W69-06564 06A

MEASUREMENT
EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
W69-06514 02G

A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

A UNIVERSAL SURFACE PRECIPITATION GAGE,
W69-06804 02B

RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
W69-06812 02B

MEIGHEN ICE CAP(CANADA)
A TEMPERATURE PROFILE THROUGH THE MEIGHEN ICE CAP, ARCTIC CANADA,
W69-06482 02C

MEL WATER
A UNIVERSAL SURFACE PRECIPITATION GAGE,
W69-06804 02B

MELTING
THE METAMORPHISM OF WET SNOW,
W69-06477 02C

METEOROLOGY
RELATIONS BETWEEN GLACIER RUNOFF AND METEOROLOGICAL FACTORS OBSERVED ON AND OUTSIDE THE GLACIER,
W69-06481 02C

MICHIGAN
SAMYN V TACEY (ARTIFICIAL DRAINAGE OF SURFACE WATERS).
W69-06593 06E

FIRES.
W69-06598 06E

GREAT LAKES COMPACT (AGREEMENT FOR EFFICIENT MANAGEMENT OF THE GREAT LAKES BASIN).
W69-06616 06E

MICROENVIRONMENT
TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
W69-06526 02D

MICROLAMINATION
FIELD OBSERVATIONS OF SOME PHYSICAL PROPERTIES IN ALLUVIAL SOILS OF ARID AND SEMI-ARID REGIONS,
W69-06515 02G

MILL DAMS
GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06662 06E

W69-06663 06E

GENERAL PROVISIONS, REGULATING TO RIVERS AND STREAMS.
W69-06664 06E

GENERAL PROVISIONS RELATING TO RIVERS AND STREAMS.
W69-06665 06E

W69-06666 06E

W69-06667 06E

W69-06668 06E

W69-06669 06E

W69-06670 06E

W69-06671 06E

MINERAL RECOVERY
A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS PART 1,
W69-06556 03C

MINERAL SERVITUDE
OHIO OIL CO V FERGUSON (MINERAL RIGHTS AND ROYALTIES).
W69-06594 06E

MINERAL WATER
GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

MINNESOTA
BINGENHEIMER V DIAMOND IRON MINING CO (DEFINITION OF NAVIGABLE WATER TO DETERMINE OWNERSHIP OF BEDS).
W69-06609 06E

BURNQUIST V FISCHER (FLOWAGE EASEMENT APPURTENANT TO DAM).
W69-06615 06E

JURISDICTION OVER WATERS.
W69-06634 06E

CERTAIN GAME PRESERVES, AREAS, PROJECTS CONTROL.
W69-06635 06E

EMINENT DOMAIN.
W69-06642 06E

WATER RESOURCES DEVELOPMENT IN MINNESOTA.
W69-06784 09D

MISSISSIPPI
BARBER PURE MILK CO V GOLDIN (SURFACE DRAINAGE).
W69-06588 06E

RUSSELL V STATE (ILLEGAL POSSESSION OF UNDERSIZED FISH).
W69-06589 06E

XIDIS V CITY OF GULFPORT (USE OF SUBMERGED LANDS FOR PUBLIC PURPOSE).
W69-06621 06E

POTEETE V CITY OF WATER VALLEY (ARTIFICIAL CONTROL OF SUBSURFACE DRAINAGE).
W69-06626 06E

CLEMENTS V TOWN OF CARROLLTON (DAM ACROSS DRAINAGE DITCH).
W69-06627 06E

ELDER V DELCOUR (MISSOURI ADHERES TO STRICT TEST OF NAVIGABILITY IN DETERMINING TITLE TO RIVER BED).
W69-06649 06E

RAINFALL-RUNOFF RELATIONS FOR SOUTHEASTERN LOUISIANA AND SOUTHWESTERN MISSISSIPPI,
W69-06829 02A

MISSISSIPPI RIVER
IOWA-WISCONSIN BRIDGE CO V UNITED STATES (LIABILITY FOR RESERVOIR OPERATION).
W69-06604 06E

MISSOURI
FLOOD PLAIN INFORMATION, WILSON CREEK AND TRIBUTARIES, SPRINGFIELD, MISSOURI-PART 1.
W69-06467 04A

STATE V TAYLOR (FISH DYNAMITED IN PRIVATE POND).
W69-06605 06E

HARDY V KANSAS CITY (FLOODING CAUSED BY OBSTRUCTION TO WATER FLOW).
W69-06625 06E

ERICKSON V GREUB (TITLE TO ACCRETION).
W69-06641 06E

MIXING
THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

MODEL STUDIES
THE DESIRABILITY AND APPLICABILITY OF SIMULATING ECOSYSTEMS,
W69-06537 06A

LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
W69-06799 02J

THE USE OF ELECTRIC ANALOG MODELS IN HYDRODYNAMICAL STUDY OF THE ALSACE AQUIFERS (FRENCH),
W69-06806 02F

MODIFIED TWO-STAGE LEAST SQUARES
SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
W69-06567 06A

MOISTURE AVAILABILITY
DROUGHT AND SOIL MOISTURE,
W69-06529 02G

MOISTURE CONTENT
TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
W69-06516 02G

A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD,
W69-06528 02G

MOISTURE TENSION
TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
W69-06516 02G

MOLECULAR STRUCTURE
INTERMOLECULAR FORCES AND THE LIQUID STATE,
W69-06838 01A

MONOMOLECULAR FILMS
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

MONTE CARLO STUDY
FIRST ORDER AUTO REGRESSION INFERENCE, ESTIMATION, AND PREDICTION,
W69-06550 06A

MONTMORILLONITE
POTASSIUM, ILLITE AND THE OCEAN,
W69-06506 02K

MOROCCO
ARTIFICIAL RECHARGE OF A FISSURED SANDSTONE AQUIFER, TANGIERS, MOROCCO (FRENCH),
W69-06487 04B

MORTALITY
A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
W69-06533 05C

MORTALITY RATES
A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
W69-06533 05C

MOVABLE DAMS
THE POSSIBILITY OF USING A MOVABLE DAM THE 'FABRIDAM' AND ITS APPLICATION IN ARID REGIONS,
W69-06455 04A

MULCHING
CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
W69-06796 03F

MULTILEVEL OPTIMIZATION
ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
W69-06813 02F

MULTIPLE EQUATION SYSTEMS
CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS IN ECONOMICS,
W69-06735 06B

MULTIPLE PURPOSE PROJECTS
OPERATION OF MULTI-UNIT MULTI-PURPOSE WATER DEVELOPMENT SYSTEMS,
W69-06462 06D

REGIONAL PLANNING FOR WATER DEVELOPMENT IN THE WESTERN UNITED STATES - THE RELEVANCE OF AMERICAN EXPERIENCE FOR OTHER NATIONS,
W69-06726 06B

NATURAL FLOW
SAMYN V TACEY (ARTIFICIAL DRAINAGE OF SURFACE WATERS).
W69-06593 06E

HANCOCK V STULL (INTERFERENCE WITH NATURAL DRAINAGE OF SURFACE WATER).
W69-06652 06E

NATURAL FLOW DOCTRINE
CANNON V CITY OF MACON (NATURAL DRAINAGE FLOW AND THE LOWER LAND PROPRIETOR).
W69-06595 06E

COX V MARTIN (DISCHARGE OF SURFACE WATER THROUGH A DOWNSPOUT).
W69-06596 06E

HARRELL V CITY OF CONWAY (USE OF IMPOUNDED WATER).
W69-06597 06E

RAU V WILDEN ACRES, INC (DIVERSION OF NATURAL FLOW BY ARTIFICIAL CHANNEL).
W69-06656 06E

RINZLER V FOLSOM (ARTIFICIAL INCREASE OF SURFACE RUNOFF).
W69-06657 06E

NATURAL RESOURCES
COMMENTS ON THE COMPETITION FOR WATER QUALITY AGRICULTURE,
W69-06576 06D

NATURAL STREAMS
NASSAU COUNTY V CHERRY VALLEY ESTATES, INC (OBSTRUCTION OF ALLEGED WATER COURSE).
W69-06592 06E

NAVIGABLE WATERS
COLEMAN V SCHAEFFER (OBSTRUCTION TO NAVIGABLE STREAM).
W69-06584 06E

BINGENHEIMER V DIAMOND IRON MINING CO (DEFINITION OF NAVIGABLE WATER TO DETERMINE OWNERSHIP OF BEDS).
W69-06609 06E

STATE V KIVETT (SUIT TO ENJOIN PRIVATE MINING OF STATE-OWNED RIVER BEDS).
W69-06629 06E

PETITION OF MARTIN (OBSTRUCTION TO NAVIGATION).
W69-06636 06E

OWEN V JOHNSON (OWNERSHIP OF THE BED OF A NAVIGABLE STREAM).
W69-06639 06E

CARNASION V PAUL (RIGHT OF A COUNTY TO TAX TIDELAND PROPERTY).
W69-06644 06E

ELDER V DELCOUR (MISSOURI ADHERES TO STRICT TEST OF NAVIGABILITY IN DETERMINING TITLE TO RIVER BED).
W69-06649 06E

NAVIGATION
BELL TEL CO V DRAVO CORP (UNDERWATER OBSTRUCTION TO NAVIGATION).
W69-06610 06E

ICE DEALERS BATHING WATER SUPPLY FOR RURAL FIRE PROTECTION.
W69-06631 06E

PETITION OF MARTIN (OBSTRUCTION TO NAVIGATION).
W69-06636 06E

SOUTHERN TRANSPORTATION CO V CITY OF NEW YORK (NEGLIGENCE OF BRIDGE OPERATOR AND TUG MASTER CAUSING BARGE COLLISION).
W69-06638 06E

NEBRASKA
FLOOD PLAIN INFORMATION, OMAHA METROPOLITAN REGION, NEBRASKA - VOLUME 1.
W69-06471 04A

NEGEV(ISRAEL)
A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

NEGLIGENT INUNDATION
HARDY V KANSAS CITY (FLOODING CAUSED BY OBSTRUCTION TO WATER FLOW).
W69-06625 06E

NETWORK DESIGN
A HEURISTIC AID FOR THE DESIGN OF SEWER NETWORKS,
W69-06498 05E

NETWORKS
USE OF DIGITAL COMPUTERS IN DISTRIBUTION SYSTEM ANALYSES,
W69-06503 07C

NEVADA
WATER-RESOURCES APPRAISAL OF THE LOWER MOAPA-LAKE MEAD AREA, CLARK COUNTY, NEVADA,
W69-06435 02F

ESTIMATED WATER USE IN NEVADA, 1950-65,
W69-06446 06D

RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
W69-06820 02F

RECLAIMED WASTE WATER IN LAS VEGAS VALLEY,
W69-06832 05D

NEW ENGLAND
SAFETY CONTROL OF PRIVATE DAMS,
W69-06433 04A

NEW JERSEY
SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

GEOLOGY AND GROUND-WATER RESOURCES OF BURLINGTON COUNTY, NEW JERSEY,
W69-06449 02F

GEOLOGY AND GROUND-WATER RESOURCES OF THE RAHWAY AREA, NEW JERSEY,
W69-06450 02F

LEONARD V STATE HIGHWAY DEPT (ACQUISITION OF TITLE BY STATE THROUGH PERMANENT FLOODING OF LAND).
W69-06611 06E

WATERS AND WATER SUPPLY.
W69-06612 06E

BAILEY V DRISCOLL (IMPLIED LIMITATION ON GRANT OF SUBMERGED LAND).
W69-06618 06E

WATER SUPPLY DISTRICTS.
W69-06630 06E

ICE DEALERS BATHING WATER SUPPLY FOR RURAL FIRE PROTECTION.
W69-06631 06E

SEWERAGE DISTRICTS AND BOARDS.
W69-06632 05G

W69-06633 06E

HUGHES V KNIGHT (RIGHT TO UNOBSTRUCTED DRAINAGE OF SURFACE WATERS).
W69-06660 06E

NEW YORK
GEORGE V STATE (OBSTRUCTION OF SUBSURFACE FLOW).
W69-06590 06E

SBARRA V ERIE RR (DRAINAGE OF SURFACE WATERS AND PRESCRIPTIVE RIGHTS).
W69-06591 06E

NASSAU COUNTY V CHERRY VALLEY ESTATES, INC (OBSTRUCTION OF ALLEGED WATER COURSE).
W69-06592 06E

LAWKINS V CITY OF NEW YORK (EROSION AND ACCRETION OF BOUNDARY SHORE LINE).
W69-06606 06E

GIBSON V STATE (CONSTRUCTION AND MAINTENANCE OF SEWERS).
W69-06607 06E

CHRISTMAN V STATE (NEGLIGENCE IN CULVERT CONSTRUCTION).
W69-06624 06E

SOUTHERN TRANSPORTATION CO V CITY OF NEW YORK (NEGLIGENCE OF BRIDGE OPERATOR AND TUG MASTER CAUSING BARGE COLLISION).
W69-06638 06E

NASSAU COUNTY V CHERRY VALLEY ESTATES (LANDOWNERS RIGHT TO PREVENT FLOW OF SURFACE WATER ONTO HIS PROPERTY).
W69-06653 06E

FLOOD PLAIN INFORMATION OF SENECA LAKE, NEW YORK.
W69-06825 04A

FLOOD PLAIN INFORMATION, CAYUGA LAKE, NEW YORK.
W69-06826 04A

FLOOD PLAIN INFORMATION, CANANDAIGUA LAKE, NEW YORK.
W69-06827 04A

NEW ZEALAND
ESTIMATION OF RAINFALL IN SPARSELY GAUGED AREAS,
W69-06773 02B

NICKEL-63
NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
W69-06766 05A

NITROGEN
THE WORK OF THE FRESHWATER BIOLOGICAL ASSOCIATION OF GREAT BRITAIN IN REGARD TO WATER SUPPLIES. (A) THE NITROGEN BALANCE OF LARGE QUANTITIES OF WATER,
W69-06538 02K

NITROGEN CYCLE
THE WORK OF THE FRESHWATER BIOLOGICAL ASSOCIATION OF GREAT BRITAIN IN REGARD TO WATER SUPPLIES. (A) THE NITROGEN BALANCE OF LARGE QUANTITIES OF WATER,
W69-06538 02K

NONLINEAR ECONOMETRIC SYSTEMS
THE ESTIMATION OF NONLINEAR ECONOMETRIC SYSTEMS,
W69-06562 06A

NONRECURSIVE MODELS
NONRECURSIVE MODELS AS DISCRETE APPROXIMATIONS TO SYSTEMS OF STOCHASTIC DIFFERENTIAL EQUATIONS,
W69-06571 06A

NONSTATIONARY PROCESS
AN HARMONIC ANALYSIS OF NONSTATIONARY MULTIVARIATE ECONOMIC PROCESSES,
W69-06553 06A

NON-DESTRUCTIVE TESTS

RX CONCRETE,
W69-06678 08F

NON-NAVIGABLE WATERS
ELDER V DELCOUR (MISSOURI ADHERES TO STRICT TEST OF NAVIGABILITY IN DETERMINING TITLE TO RIVER BED).
W69-06649 06E

NORTH CAROLINA
FLOOD INUNDATION AND EFFECTS OF URBANIZATION IN METROPOLITAN CHARLOTTE, NORTH CAROLINA,
W69-06445 04C

NANTAHALA POWER AND LIGHT CO V SLOAN (FLOWAGE EASEMENTS).
W69-06620 06E

NORTHEAST U S
DROUGHT IN THE NORTHEASTERN UNITED STATES,
W69-06436 02B

THE ABNORMALLY DRY WEATHER OF 1961-1966 IN THE NORTHEASTERN UNITED STATES,
W69-06437 02B

FURTHER STUDIES OF DROUGHT OVER NORTHEASTERN UNITED STATES,
W69-06438 02B

EFFECTS OF THE DROUGHT ON WATER RESOURCES-SURFACE AND SUBSURFACE HYDROLOGY,
W69-06440 02B

NORTHEASTERN U S DROUGHT (1961-67)
DROUGHT IN THE NORTHEASTERN UNITED STATES,
W69-06436 02B

NUCLEAR ENERGY
THE ROLE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IN THE DEVELOPMENT, USE AND CONTROL OF WATER RESOURCES.
W69-06456 03A

NUCLEAR REACTORS,
W69-06582 03A

NUCLEAR EXPLOSIONS
NUCLEAR EXPLOSIVES,
W69-06581 08H

NUCLEAR TECHNIQUES(HYDROLOGY)
GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
W69-06811 07B

OBSTRUCTION TO FLOW
NASSAU COUNTY V CHERRY VALLEY ESTATES, INC (OBSTRUCTION OF ALLEGED WATER COURSE).
W69-06592 06E

CITY OF PORTSMOUTH V CULPEPPER (SUIT FOR DAMAGES RESULTING FROM OVERFLOW OF OBSTRUCTED CANAL).
W69-06602 06E

ZOMBKOWSKI V WISCONSIN RIVER POWER CO (FLOODING DAMAGES CAUSED BY DAM CONSTRUCTION).
W69-06603 06E

HARDY V KANSAS CITY (FLOODING CAUSED BY OBSTRUCTION TO WATER FLOW).
W69-06625 06E

CLEMENTS V TOWN OF CARROLLTON (DAM ACROSS DRAINAGE DITCH).
W69-06627 06E

HANCOCK V STULL (INTERFERENCE WITH NATURAL DRAINAGE OF SURFACE WATER).
W69-06652 06E

NASSAU COUNTY V CHERRY VALLEY ESTATES (LANDOWNERS RIGHT TO PREVENT FLOW OF SURFACE WATER ONTO HIS PROPERTY).
W69-06653 06E

OBSTRUCTION TO NAVIGATION
BELL TEL CO V DRAVO CORP (UNDERWATER OBSTRUCTION TO NAVIGATION).
W69-06610 06E

PETITION OF MARTIN (OBSTRUCTION TO NAVIGATION).
W69-06636 06E

OCCUPATIONS
MANPOWER REQUIREMENTS FOR POLLUTION CONTROL AND WATER RESOURCES IN INDIANA AND A RELATED POLLUTION CONTROL TECHNOLOGY CURRICULUM,
W69-06507 05G

OCEANS
POTASSIUM, ILLITE AND THE OCEAN,
W69-06506 02K

OHIO
FLOOD PLAIN INFORMATION, ROCKY RIVER IN CITIES OF ROCKY RIVER AND LAKEWOOD, CUYAHOGA COUNTY, OHIO.
W69-06468 04A

COLEMAN V SCHAEFFER (OBSTRUCTION TO NAVIGABLE STREAM).
W69-06584 06E

STATE V CITY OF CLEVELAND (RIGHT OF ACCESS TO NAVIGABLE WATERS).
W69-06619 06E

OIL INDUSTRY
OHIO OIL CO V FERGUSON (MINERAL RIGHTS AND ROYALTIES).
W69-06594 06E

OIL SPILLS
OIL AND HAZARDOUS MATERIALS-EMERGENCY PROCEDURES IN THE WATER ENVIRONMENT.
W69-06791 05G

OILS
TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

ONE-STEP METHOD
SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD,
W69-06528 02G

OPEN CHANNEL FLOW
DYNAMICS OF CHANNEL FLOW,
W69-06835 02E

OPERATION AND MAINTENANCE
SAFETY CONTROL OF PRIVATE DAMS,
W69-06433 04A

OPPORTUNITY COST
THE OPPORTUNITY COSTS OF PUBLIC INVESTMENT,
W69-06739 06B

OPTIMALITY
OPTIMALITY OF IMPERFECTLY COMPETITIVE RESOURCE ALLOCATION,
W69-06722 06C

OPTIMIZATION
OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
W69-06495 03A

A HEURISTIC AID FOR THE DESIGN OF SEWER NETWORKS,
W69-06498 05E

ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
W69-06813 02F

OPTIMUM DEVELOPMENT PLANS
OPERATION OF MULTI-UNIT MULTI-PURPOSE WATER DEVELOPMENT SYSTEMS,
W69-06462 06D

ORAL AGREEMENTS
PRODERMAN V DIETZ (PRIVATE DAMS FOR FLOOD CONTROL).
W69-06617 06E

OUT-OF-KILTER ALGORITHM
SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE.
W69-06494 04A

OVERDRAFT
EFFECT OF SUBSIDENCE ON WELL FIELDS,
W69-06763 04B

OVERFLOW
CITY OF PORTSMOUTH V CULPEPPER (SUIT FOR DAMAGES RESULTING FROM OVERFLOW OF OBSTRUCTED CANAL).
W69-06602 06E

BURNQUIST V FISCHER (FLOWAGE EASEMENT APPURTENANT TO DAM).
W69-06615 06E

OVERVOLTAGE
SHUNT CAPACITOR ENERGIZATION WITH VACUUM INTERRUPTERS--A POSSIBLE SOURCE OF OVERVOLTAGE,
W69-06689 08C

OWNERSHIP OF BEDS
UNITED STATES V GROEN (TITLE TO FILLED IN LAND BORDERING ON A RIVER).
W69-06608 06E

BINGENHEIMER V DIAMOND IRON MINING CO (DEFINITION OF NAVIGABLE WATER TO DETERMINE OWNERSHIP OF BEDS).
W69-06609 06E

LEONARD V STATE HIGHWAY DEPT (ACQUISITION OF TITLE BY STATE THROUGH PERMANENT FLOODING OF LAND).
W69-06611 06E

CALIFORNIA CO V PRICE (OWNERSHIP OF NAVIGABLE WATER BED).
W69-06613 06E

BAILEY V DRISCOLL (IMPLIED LIMITATION ON GRANT OF SUBMERGED LAND).
W69-06618 06E

STATE V CITY OF CLEVELAND (RIGHT OF ACCESS TO NAVIGABLE WATERS).
W69-06619 06E

UNITED STATES V TURNER (OWNERSHIP OF BEDS UNDER SHALLOW WATERS).
W69-06628 06E

STATE V KIVETT (SUIT TO ENJOIN PRIVATE MINING OF STATE-OWNED RIVER BEDS).
W69-06629 06E

HAYNES V SMITH (PRIVATE COMMERCIAL VENTURES ON PUBLIC WATERS).
W69-06643 06E

ELDER V DELCOUR (MISSOURI ADHERES TO STRICT TEST OF NAVIGABILITY IN DETERMINING TITLE TO RIVER BED).
W69-06649 06E

SKALITSKY V CONSOL BADGER CO-OPERATIVE (OWNERSHIP OF FILLED POND BED).
W69-06650 06E

OXYGEN SAG
STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
W69-06500 05B

PACIFIC NORTHWEST U S
SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
W69-06725 06B

PACIFIC OCEAN
NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
W69-06766 05A

PARETO-OPTIMALITY
OPTIMALITY OF IMPERFECTLY COMPETITIVE RESOURCE ALLOCATION,
W69-06722 06C

PATH OF POLLUTANTS
DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
W69-06785 05B

PAVING
USE OF ASPHALTIC CONCRETE IN COASTAL AND CANAL CONSTRUCTION,
W69-06682 08F

PEARSON TYPE III DISTRIB
A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
W69-06680 02E

PENNSYLVANIA
EFFECTS OF MINE DRAINAGE ON GROUND WATER,
W69-06425 05C

WHITE OAK BOROUGH AUTH V PENN PUB U COMM'N (AQUISITION OF PUBLIC WATER FACILITIES).
W69-06601 06E

BELL TEL CO V DRAVO CORP (UNDERWATER OBSTRUCTION TO NAVIGATION).
W69-06610 06E

PETITION OF MARTIN (OBSTRUCTION TO NAVIGATION).
W69-06636 06E

RAU V WILDEN ACRES, INC (DIVERSION OF NATURAL FLOW BY ARTIFICIAL CHANNEL).
W69-06656 06E

PERCHED WATER
THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
W69-06758 02F

PERCOLATING WATER
GEORGE V STATE (OBSTRUCTION OF SUBSURFACE FLOW).
W69-06590 06E

PERMEABILITY
LIQUID PERMEABILITY OF SNOW,
W69-06478 02C

PERMEAMETERS
LIQUID PERMEABILITY OF SNOW,
W69-06478 02C

PERMITS
SEWERS AND DRAINS PRIVATE DRAINS.
W69-06661 06E

PERPETUAL FLOWAGE EASEMENTS
BURNQUIST V FISCHER (FLOWAGE EASEMENT APPURTENANT TO DAM).
W69-06615 06E

PHENOLS
FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-III. A STUDY OF PHENOL CONTENT IN SURFACE WATERS,
W69-06444 05A

PHOTOGRAMMETRY
GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
W69-06681 07B

SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

COMPUTER-AIRPLANE COMBO SAVES QUARTER MILLION DOLLARS ON SURVEYS AND ADMINISTRATION OF CONSTRUCTION CONTRACTS,
W69-06697 07B

PHOTOGRAPHY
PRELIMINARY REMOTE SENSING OF THE DELAWARE ESTUARY,
W69-06793 02L

PHOTOINTERPRETATION
GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
W69-06681 07B

SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

PHOTOSYNTHESIS
PHOTOSYNTHESIS AND WATER USE BY SALTCEDAR,
W69-06771 03B

PHREATOPHYTES
PHOTOSYNTHESIS AND WATER USE BY SALTCEDAR,
W69-06771 03B

PHYSICAL PROPERTIES
THE METAMORPHISM OF DRY SNOW AT A UNIFORM TEMPERATURE,
W69-06479 02C

PHYTOPLANKTON
APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
W69-06540 07B

SPECIES DIVERSITY AND COMMUNITY STRUCTURE IN LACUSTRINE PHYTOPLANKTON,
W69-06542 02H

PIERS
CARNASION V PAUL (RIGHT OF A COUNTY TO TAX TIDELAND PROPERTY).
W69-06644 06E

PIPELINES
PIPELINE PLANNING BY DYNAMIC COMPUTER PROGRAMMING,
W69-06493 06A

TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMM'N (PIPELINES ACROSS NAVIGABLE CHANNELS).
W69-06587 06E

PRESSURE TRANSIENTS IN HYDRAULIC PIPELINES,
W69-06700 08A

PLANNING
INTERGOVERNMENTAL PLANNING OF WATER RESOURCES,
W69-06429 06B

PIPELINE PLANNING BY DYNAMIC COMPUTER PROGRAMMING,
W69-06493 06A

WATER FOR TEXAS,
W69-06790 06B

PLANT GROWTH
TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

PLASTIC DEFORMATION
THE MECHANICAL PROPERTIES OF SINGLE CRYSTALS OF ICE AT LOW TEMPERATURES,
W69-06474 02C

DEFORMATION OF POLYCRYSTALLINE ICE UNDER COMBINED UNIAXIAL AND HYDROSTATIC PRESSURE,
W69-06475 02C

THE IMPORTANCE OF THE HYDROGEN ATOM ARRANGEMENT IN DETERMINING HOW ICE CAN DEFORM PLASTICALLY,
W69-06476 02C

POLICY MATTERS
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

POLLUTANT IDENTIFICATION
OIL AND HAZARDOUS MATERIALS-EMERGENCY PROCEDURES IN THE WATER ENVIRONMENT.
W69-06791 05G

POLLUTANTS
OIL AND HAZARDOUS MATERIALS-EMERGENCY PROCEDURES IN THE WATER ENVIRONMENT.
W69-06791 05G

POLLUTION ABATEMENT
WATER SUPPLY AND WASTEWATER TREATMENT PROBLEMS OF INDUSTRIAL AND TRADE ENTERPRISES,
W69-06723 05D

POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
W69-06802 05B

PONDING
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

PONDS
APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
W69-06540 07B

HAMMEL V CAMP RANGER, INC (PRESUMPTIONS REGARDING CONVEYANCE OF INLAND, NON-NAVIGABLE POND).
W69-06648 06E

POPULATION DYNAMICS
APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
W69-06540 07B

POPULATION TRENDS
FORECASTING URBAN WATER DEMANDS IN DEVELOPING COUNTRIES,
W69-06727 06D

POROUS MEDIA FLOW
EXTENDED TECHNIQUES OF CALCULATION OF SOIL-WATER MOVEMENT, WITH SOME PHYSICAL CONSEQUENCES,
W69-06714 02G

PORTALES VALLEY(NEW MEXICO)
ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
W69-06509 02F

POTASSIUM
POTASSIUM, ILLITE AND THE OCEAN,
W69-06506 02K

POWDER
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

POWER CABLES
ELECTRICAL FEATURES OF THE GRAND COULEE THIRD POWER PLANT,
W69-06684 08C

POWER SUPPLIES
INNOVATIONS AND THE FUTURE OF CATHODIC PROTECTION,
W69-06677 08A

PRECIPITATION GAGES
A UNIVERSAL SURFACE PRECIPITATION GAGE,
W69-06804 02B

PRECIPITATION PATTERNS
STREAMFLOW RECORD LENGTH FOR MODELLING CATCHMENT DYNAMICS,
W69-06781 02E

PRECIPITATION-BASE FLOW RELATIONS
PRECIPITATION AND BASE FLOW VARIABILITY,
W69-06443 02B

PRECIPITATION(ATMOSPHERIC)
DROUGHT IN THE NORTHEASTERN UNITED STATES,
W69-06436 02B

RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
W69-06812 02B

PRESCRIPTIVE RIGHTS
SBARRA V ERIE RR (DRAINAGE OF SURFACE WATERS AND PRESCRIPTIVE RIGHTS).
W69-06591 06E

SAMYN V TACEY (ARTIFICIAL DRAINAGE OF SURFACE WATERS).
W69-06593 06E

OHIO OIL CO V FERGUSON (MINERAL RIGHTS AND ROYALTIES).
W69-06594 06E

DRAPER V HOSHIER (INTERFERENCE WITH DRAINAGE DITCH).
W69-06600 06E

BURNQUIST V FISCHER (FLOWAGE EASEMENT APPURTENANT TO DAM).
W69-06615 06E

SAVOIE V TOWN OF BOURBONNAIS (PRESCRIPTIVE RIGHTS).
W69-06655 06E

HUGHES V KNIGHT (RIGHT TO UNOBSTRUCTED DRAINAGE OF SURFACE WATERS).
W69-06660 06E

PRESSURE CONDUITS
COMPUTATION OF PRESSURES AND VELOCITIES IN THE CURVILINEAR ZONE OF PRESSURE SPILLWAYS, FOR PREDICTING CAVITATION,
W69-06713 08B

PRESSURE WAVES
PRESSURE TRANSIENTS IN HYDRAULIC PIPELINES,
W69-06700 08A

PRICE INSTABILITY
CONSUMER ASPECTS OF PRICE INSTABILITY,
W69-06570 06C

PRICE STABILITY
CONSUMER ASPECTS OF PRICE INSTABILITY,
W69-06570 06C

PRICING
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W69-06502 06D

PUBLIC UTILITY PRICING AND OUTPUT UNDER RISK,
W69-06549 06C

PROBABILITY
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

PROFESSIONAL PERSONNEL
MANPOWER REQUIREMENTS FOR POLLUTION CONTROL AND WATER RESOURCES IN INDIANA AND A RELATED POLLUTION CONTROL TECHNOLOGY CURRICULUM,
W69-06507 05G

PROFIT
THE INFLUENCE OF OWNERSHIP AND CONTROL ON PROFIT RATES,
W69-06545 06B

PROJECT DESIGN
THE ROLE OF ALTERNATIVE COST IN PROJECT DESIGN AND SELECTION,
W69-06738 06B

PROJECT SELECTION
THE ROLE OF ALTERNATIVE COST IN PROJECT DESIGN AND SELECTION,
W69-06738 06B

PROPRIETARY POWER
EARLE V MCCARTY (TITLE TO LAND BETWEEN SOUND AND DEDICATED ROAD).
W69-06646 06E

PROTECTION(ELECTRICAL)
SOME ASPECTS OF INSULATION CO-ORDINATION IN HVDC SYSTEMS,
W69-06707 08C

BROWN BOVERI DISTANCE PROTECTION SYSTEMS EMPLOYING CARRIER TRANSFER,
W69-06709 08C

DISTANCE PROTECTION OF HIGH-VOLTAGE LINES CONTAINING SERIES CAPACITORS,
W69-06710 08C

PROTECTIVE DISTANCE
BROWN BOVERI DISTANCE PROTECTION SYSTEMS EMPLOYING CARRIER TRANSFER,
W69-06709 08C

DISTANCE PROTECTION OF HIGH-VOLTAGE LINES CONTAINING SERIES CAPACITORS,
W69-06710 08C

PUBLIC INVESTMENT
THE OPPORTUNITY COSTS OF PUBLIC INVESTMENT,
W69-06739 06B

CHOOSING AMONG ALTERNATIVE PUBLIC INVESTMENTS IN THE WATER RESOURCE FIELD,
W69-06740 06B

PUBLIC LANDS
CERTAIN GAME PRESERVES, AREAS, PROJECTS CONTROL.
W69-06635 06E

PUBLIC SERVITUDES
DAVIS V CITY OF ALEXANDRIA (PUBLIC USE OF LEVEE BANK AS ROADWAY).
W69-06645 06E

PUERTO RICO
FLOOD PLAIN INFORMATION, GUAYANILLA RIVER, GUAYANILLA, PUERTO RICO.
W69-06473 04A

PONADELLAS V UNITED STATES (TEMPORARY TAKING OF PROPERTY FOR PUBLIC PURPOSE).
W69-06622 06E

PUMPING
EFFECT OF SUBSIDENCE ON WELL FIELDS,
W69-06763 04B

QUADRATIC HILL-CLIMBING
MAXIMIZATION BY QUADRATIC HILL-CLIMBING,
W69-06564 06A

QUADRATIC PROGRAMMING
A PARAMETRIC SIMPLICAL FORMULATION OF HOUTHAKKER'S CAPACITY METHOD,
W69-06568 06A

QUASILINEARIZATION
QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
W69-06822 02A

QUICK CLAYS
STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

RADAR
POTENTIAL OF RADAR REMOTE SENSORS AS TOOLS IN RECONNAISSANCE GEOMORPHIC, VEGETATION AND SOIL MAPPING,
W69-06718 07B

RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
W69-06812 02B

RADAR STORM-MEASUREMENT
RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
W69-06812 02B

RADIATION
WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
W69-06756 03F

THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

RADIOACTIVE SEDIMENT TRANSPORT
DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
W69-06785 05B

RADIOACTIVE WASTE DISPOSAL

DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
W69-06785 05B

RADIOACTIVITY EFFECTS
PROGRESS REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY, BEAUFORT, N. C., FISCAL YEAR 1968,
W69-06769 09C

RADIOACTIVITY TECHNIQUES
NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
W69-06766 05A

GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
W69-06811 07B

RADIOECOLOGICAL RESEARCH
PROGRESS REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY, BEAUFORT, N. C., FISCAL YEAR 1968,
W69-06769 09C

RADIOECOLOGY
NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
W69-06766 05A

PROGRESS REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY, BEAUFORT, N. C., FISCAL YEAR 1968,
W69-06769 09C

RADIOISOTOPES
USE OF TRACER TECHNIQUE IN SOIL EROSION RESEARCH,
W69-06704 04D

DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
W69-06785 05B

GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
W69-06811 07B

RADIONUCLIDES
NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
W69-06766 05A

RAIN GAGES
ESTIMATION OF RAINFALL IN SPARSELY GAUGED AREAS,
W69-06773 02B

RAINDROPS
PREDICTION OF RAINSPLASH EROSION IN THE SEASONALLY WET TROPICS,
W69-06768 02J

RAINFALL
RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
W69-06812 02B

RAINFALL DISPOSITION
FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL, U.S. COASTAL REGION, GULF OF MEXICO,
W69-06797 02B

RAINFALL INTENSITY
FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL, U.S. COASTAL REGION, GULF OF MEXICO,
W69-06797 02B

RAINFALL PATTERN
PLANNING AND DEVELOPMENT OF WATER RESOURCES IN INDIA,
W69-06728 06B

RAINFALL-RUNOFF RELATIONSHIPS
RELATION OF A HYDROLOGIC INDEX TO MEAN ANNUAL FLOW,
W69-06441 02B

PRECIPITATION AND BASE FLOW VARIABILITY,
W69-06443 02B

AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
W69-06770 04C

STREAMFLOW RECORD LENGTH FOR MODELLING CATCHMENT DYNAMICS,
W69-06781 02E

EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
W69-06789 02A

RAINFALL-RUNOFF RELATIONS FOR SOUTHEASTERN LOUISIANA AND SOUTHWESTERN MISSISSIPPI,
W69-06829 02A

IMPROVED TECHNIQUES FOR ESTIMATING RUNOFF WITH BRIEF RECORDS,
W69-06830 02E

REASONABLE USE
HARRELL V CITY OF CONWAY (USE OF IMPOUNDED WATER).
W69-06597 06E

HARRIS V BROOKS (RECREATION RIGHTS OF RIPARIAN OWNER).
W69-06599 06E

RECHARGE
CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
W69-06796 03F

RECREATION
THE COMPETITION FOR WATER QUALITY RECREATION,
W69-06573 06D

THE COMPETITION FOR WATER QUANTITY RECREATION,
W69-06578 06D

HARRIS V BROOKS (RECREATION RIGHTS OF RIPARIAN OWNER).
W69-06599 06E

REGIMEN
RECENT HISTORY OF GULKANA AND COLLEGE GLACIERS, CENTRAL ALASKA RANGE, ALASKA,
W69-06808 02C

REGIONAL ANALYSIS
PRINCIPLES OF CHOOSING EXPERIMENTAL PLOTS FOR WATER BALANCE STUDIES IN IRRIGATION REGIONS OF THE ARID ZONE,
W69-06523 02G

REGRESSION ANALYSIS
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W69-06502 06D

THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

TESTING SINGLE-EQUATION LEAST SQUARES REGRESSION MODELS FOR AUTOCORRELATED DISTURBANCES,
W69-06565 06A

REGRESSION MODELS
TESTING SINGLE-EQUATION LEAST SQUARES REGRESSION MODELS FOR AUTOCORRELATED DISTURBANCES,
W69-06565 06A

REGULATION
SAFETY CONTROL OF PRIVATE DAMS,
W69-06433 04A

REINFORCED CONCRETE
TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

SHEAR TRANSFER IN REINFORCED CONCRETE,
W69-06676 08F

RELIABILITY
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

REMOTE SENSING
POTENTIAL OF RADAR REMOTE SENSORS AS TOOLS IN RECONNAISSANCE GEOMORPHIC, VEGETATION AND SOIL MAPPING,
W69-06718 07B

PRELIMINARY REMOTE SENSING OF THE DELAWARE ESTUARY,
W69-06793 02L

RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
W69-06812 02B

REPULSION(LEGAL ASPECTS)
SAVOIE V TOWN OF BOURBONNAIS (PRESCRIPTIVE RIGHTS).
W69-06655 06E

RESEARCH FACILITIES
PROGRESS REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY, BEAUFORT, N. C., FISCAL YEAR 1968,
W69-06769 09C

RESERVOIR EVAPORATION
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

RESERVOIR OPERATION
SAFETY CONTROL OF PRIVATE DAMS,
W69-06433 04A

RESERVOIR MANAGEMENT THE TRADEOFF BETWEEN LOW-FLOW REGULATION AND FLOOD CONTROL,
W69-06496 04A

HEC-3, RESERVIOR SYSTEM ANALYSIS.
W69-06788 04A

RESERVOIR SYSTEM ANALYSIS
HEC-3, RESERVIOR SYSTEM ANALYSIS.
W69-06788 04A

RESERVOIRS
WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1966-SEPTEMBER 1967,
W69-06786 02H

RESOURCE ALLOCATION
OPTIMALITY OF IMPERFECTLY COMPETITIVE RESOURCE ALLOCATION,
W69-06722 06C

RESOURCE USE PLANNING

SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
W69-06725 06B

RETENTION DAMS
DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
W69-06675 05G

RETURNS TO SCALE
ESTIMATION OF RETURNS TO SCALE AND THE ELASTICITY OF SUBSTITUTION,
W69-06732 06B

RHODE ISLAND
POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
W69-06802 05B

RIDDANCE(LEGAL ASPECTS)
SAVOIE V TOWN OF BOURBONNAIS (PRESCRIPTIVE RIGHTS).
W69-06655 06E

RIGHT OF ACCESS
UNITED STATES V TURNER (OWNERSHIP OF BEDS UNDER SHALLOW WATERS).
W69-06628 06E

RIPARIAN GRANTS
LEONARD V STATE HIGHWAY DEPT (ACQUISITION OF TITLE BY STATE THROUGH PERMANENT FLOODING OF LAND).
W69-06611 06E

RIPARIAN RIGHTS
HARRELL V CITY OF CONWAY (USE OF IMPOUNDED WATER).
W69-06597 06E

HARRIS V BROOKS (RECREATION RIGHTS OF RIPARIAN OWNER).
W69-06599 06E

UNITED STATES V GROEN (TITLE TO FILLED IN LAND BORDERING ON A RIVER).
W69-06608 06E

OWEN V JOHNSON (OWNERSHIP OF THE BED OF A NAVIGABLE STREAM).
W69-06639 06E

EMINENT DOMAIN.
W69-06642 06E

RIPARIAN WATERS
BENEFICIAL USES OF WATERS OF INTERNATIONAL RIVERS INTERNATIONAL LAW AND PRACTICE,
W69-06458 06E

RIVER BASIN DEVELOPMENT
CONSTRUCTION AND MANAGEMENT OF RIVER VALLEY PROJECTS IN INDIA,
W69-06457 04A

OPERATION OF MULTI-UNIT MULTI-PURPOSE WATER DEVELOPMENT SYSTEMS,
W69-06462 06D

RIVER BASINS
BENEFICIAL USES OF WATERS OF INTERNATIONAL RIVERS INTERNATIONAL LAW AND PRACTICE,
W69-06458 06E

RIVER SYSTEMS
WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
W69-06499 05G

PLANNING AND DEVELOPMENT OF WATER RESOURCES IN INDIA,
W69-06728 06B

RIVERS
STATE V KIVETT (SUIT TO ENJOIN PRIVATE MINING OF STATE-OWNED RIVER BEDS).
W69-06629 06E

ROAD CONSTRUCTION
CHRISTMAN V STATE (NEGLIGENCE IN CULVERT CONSTRUCTION).
W69-06624 06E

ROCK MECHANICS
BRITTLE ROCK FAILURE UNDER TRIAXIAL STRESS,
W69-06701 08E

ROCK PROPERTIES
BRITTLE ROCK FAILURE UNDER TRIAXIAL STRESS,
W69-06701 08E

ROCKFILL DAMS
FOUNDATION PROBLEMS OF RUEDI DAM AND RESERVOIR,
W69-06673 08E

ROTATING MACHINES
MEASUREMENT OF ROTATING MACHINERY VIBRATION AND FACTORS AFFECTING INSTRUMENT ACCURACY,
W69-06702 07B

ROUTING
HEC-3, RESERVIOR SYSTEM ANALYSIS.
W69-06788 04A

RUNOFF
A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

GRADED FURROWS FOR WATER EROSION CONTROL,
W69-06746 02J

RUNOFF FORECASTING
IMPROVED TECHNIQUES FOR ESTIMATING RUNOFF WITH BRIEF RECORDS,
W69-06830 02E

RURAL AREAS
RURAL WATER DEVELOPMENT IN KENYA,
W69-06453 04A

SAFETY
SAFETY CONTROL OF PRIVATE DAMS,
W69-06433 04A

NON-ENGINEERING ELEMENTS IN FACTORS OF SAFETY IN SOIL AND FOUNDATION ENGINEERING,
W69-06695 08D

SAFETY FACTORS
NON-ENGINEERING ELEMENTS IN FACTORS OF SAFETY IN SOIL AND FOUNDATION ENGINEERING,
W69-06695 08D

SALINE SOILS
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W69-06716 03F

SALINE WATER INTRUSION
CONTROL OF SEA-WATER INTRUSION IN A GROUND-WATER AQUIFER,
W69-06422 02F

SALINITY
ECONOMIC FRAMEWORK FOR SALINITY CONTROL PROJECTS,
W69-06490 05D

SALT BALANCE
SALT BALANCE AND SALT TRANSPORT PROCESSES IN IRRIGATED SOILS,
W69-06717 03F

SALT SPRAY TESTS
TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH VOLTAGE INSULATORS.
W69-06708 08C

SALTS
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

FIELD OBSERVATIONS OF SOME PHYSICAL PROPERTIES IN ALLUVIAL SOILS OF ARID AND SEMI-ARID REGIONS,
W69-06515 02G

SALT BALANCE AND SALT TRANSPORT PROCESSES IN IRRIGATED SOILS,
W69-06717 03F

STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

SAMPLING
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

SAN JOAQUIN VALLEY
THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
W69-06758 02F

SAND GRAIN ORIENTATION
LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
W69-06799 02J

SANDS
TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A CARBONATE BEACH, BIMINI, BWI,
W69-06809 02L

SANDSTONES
ARTIFICIAL RECHARGE OF A FISSURED SANDSTONE AQUIFER, TANGIERS, MOROCCO (FRENCH),
W69-06487 04B

SANTA CLARA VALLEY
EFFECT OF SUBSIDENCE ON WELL FIELDS,
W69-06763 04B

SEA WATER
THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

SEDIMENT TRANSPORT
DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
W69-06785 05B

DYNAMICS OF CHANNEL FLOW,
W69-06835 02E

SEDIMENTARY ROCKS
SOME DETAILS ON THE CIRCULATION OF GROUNDWATER IN NON-KARSTIFIED FISSURED FORMATIONS IN CZECHOSLOVAKIA (FRENCH),

W69-06485 02F

SEDIMENTATION
COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
W69-06798 02L

TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A CARBONATE BEACH, BIMINI, BWI,
W69-06809 02L

A CLASSIFICATION OF PALEOCURRENT MODELS,
W69-06810 02J

SEDIMENTOLOGY
A CLASSIFICATION OF PALEOCURRENT MODELS,
W69-06810 02J

SEDIMENTS
LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
W69-06799 02J

SEEPAGE
THE MECHANISM OF WATER SEEPAGE THROUGH CONCRETE,
W69-06712 08F

SEMIARID CLIMATE
SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
W69-06524 02G

SEMIARID CLIMATES
A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
W69-06513 02J

SERIAL CORRELATION
SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS.
W69-06569 06A

SERIES CAPACITORS
DISTANCE PROTECTION OF HIGH-VOLTAGE LINES CONTAINING SERIES CAPACITORS,
W69-06710 08C

SERVICE LIFE
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

SETTLEMENT
HORIZONTAL MOVEMENTS RELATED TO SUBSIDENCE,
W69-06692 08D

SEWAGE DISPOSAL
SEWERAGE DISTRICTS AND BOARDS.
W69-06632 05G

SEWAGE DISTRICTS
SEWERAGE DISTRICTS AND BOARDS.
W69-06633 06E

SEWERS
GIBSON V STATE (CONSTRUCTION AND MAINTENANCE OF SEWERS).
W69-06607 06E

SEWERS COST COMPARISONS
A HEURISTIC AID FOR THE DESIGN OF SEWER NETWORKS,
W69-06498 05E

SHALLOW WATER
UNITED STATES V TURNER (OWNERSHIP OF BEDS UNDER SHALLOW WATERS).
W69-06628 06E

SHEARING SAND
LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
W69-06799 02J

SHIPS
BELL TEL CO V DRAVO CORP (UNDERWATER OBSTRUCTION TO NAVIGATION).
W69-06610 06E

SHORE PROTECTION
USE OF ASPHALTIC CONCRETE IN COASTAL AND CANAL CONSTRUCTION,
W69-06682 08F

SHORES
A CLASSIFICATION OF PALEOCURRENT MODELS,
W69-06810 02J

SHORT-WAVE RADIATION
THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

SIERRA NEVADA(CALIF)
REGIONAL HYDROLOGIC AREA STUDY AS AN ANALYSIS TOOL IN WEATHER MODIFICATION,
W69-06805 02A

SILICONES
TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

SIMULATION ANALYSIS
SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE.
W69-06494 04A

WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
W69-06499 05G

DYNAMIC SIMULATION MODEL OF THE TRANSPIRATION PROCESS,
W69-06504 02D

SIMULATION OF AN AQUATIC ECOSYSTEM,
W69-06536 02H

THE DESIRABILITY AND APPLICABILITY OF SIMULATING ECOSYSTEMS,
W69-06537 06A

SIMULTANEOUS EQUATION MODEL
SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
W69-06567 06A

SIMULTANEOUS TESTS
SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS,
W69-06569 06A

SLIP SURFACE
CIRCULAR AND LOGARITHMIC SPIRAL SLIP SURFACES,
W69-06694 08D

SLOPE STABILITY
CIRCULAR AND LOGARITHMIC SPIRAL SLIP SURFACES,
W69-06694 08D

SLOPES
GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
W69-06681 07B

GRADED FURROWS FOR WATER EROSION CONTROL,
W69-06746 02J

SLUDGE DISPOSAL
SLUDGE DISPOSAL ALTERNATIVES -- SOCIO-ECONOMIC CONSIDERATIONS,
W69-06492 05E

SMALL-SAMPLING PROPERTIES
ON THE RELATIVE SMALL-SAMPLE PROPERTIES OF SEVERAL STRUCTURAL-EQUATION ESTIMATORS,
W69-06734 06B

SNAKE RIVER PLAIN
INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO,
W69-06427 02E

SNOW
THE METAMORPHISM OF WET SNOW,
W69-06477 02C

LIQUID PERMEABILITY OF SNOW,
W69-06478 02C

THE METAMORPHISM OF DRY SNOW AT A UNIFORM TEMPERATURE,
W69-06479 02C

SNOW MANAGEMENT
A SYSTEM FOR MAKING REMOTE AND UNDISTURBED MEASUREMENTS OF SNOW SETTLEMENT AND TEMPERATURES,
W69-06803 02C

SNOW PRESSURE RECORDER
A UNIVERSAL SURFACE PRECIPITATION GAGE,
W69-06804 02B

SNOW SURVEYS
A SYSTEM FOR MAKING REMOTE AND UNDISTURBED MEASUREMENTS OF SNOW SETTLEMENT AND TEMPERATURES,
W69-06803 02C

SNOWPACK
A UNIVERSAL SURFACE PRECIPITATION GAGE,
W69-06804 02B

SNOWPACKS
A SYSTEM FOR MAKING REMOTE AND UNDISTURBED MEASUREMENTS OF SNOW SETTLEMENT AND TEMPERATURES,
W69-06803 02C

SOCIAL VALUES
SLUDGE DISPOSAL ALTERNATIVES -- SOCIO-ECONOMIC CONSIDERATIONS,
W69-06492 05E

SOCIO-ECONOMIC CONSIDERATIONS
SLUDGE DISPOSAL ALTERNATIVES -- SOCIO-ECONOMIC CONSIDERATIONS,
W69-06492 05E

SODIUM ARSENITE
ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

SOIL ENGINEERING
SOIL AS AN ENGINEERING MATERIAL,
W69-06699 08D

SOIL EROSION
USE OF TRACER TECHNIQUE IN SOIL EROSION RESEARCH,
W69-06704 04D

SOIL MAPS
POTENTIAL OF RADAR REMOTE SENSORS AS TOOLS IN RECONNAISSANCE GEOMORPHIC, VEGETATION AND SOIL MAPPING,

W69-06718 07B

SOIL MECHANICS
SOIL AS AN ENGINEERING MATERIAL,
W69-06699 08D

STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

SOIL MOISTURE
THEORY OF SOIL MOISTURE - VOL 1, MOISTURE PROPERTIES OF SOILS AND MOVEMENT OF SOIL MOISTURE,
W69-06489 02G

EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
W69-06514 02G

THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

DROUGHT AND SOIL MOISTURE,
W69-06529 02G

EXTENDED TECHNIQUES OF CALCULATION OF SOIL-WATER MOVEMENT, WITH SOME PHYSICAL CONSEQUENCES,
W69-06714 02G

SOIL MOISTURE BUDGET
THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

SOIL MOISTURE METERS
EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
W69-06514 02G

SOIL PHYSICAL PROPERTIES
FIELD OBSERVATIONS OF SOME PHYSICAL PROPERTIES IN ALLUVIAL SOILS OF ARID AND SEMI-ARID REGIONS,
W69-06515 02G

PREDICTION OF SWELLING PRESSURE OF CLAYS,
W69-06693 08D

SOIL RECLAMATION
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W69-06716 03F

SOIL SALINITY CONTROL
PROCEEDINGS OF TILE DRAINAGE RESEARCH CONFERENCE,
W69-06795 04A

SOIL SCIENCE
SALT BALANCE AND SALT TRANSPORT PROCESSES IN IRRIGATED SOILS,
W69-06717 03F

SOIL STABILIZATION
STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

SOIL SURFACES
FIELD OBSERVATIONS OF SOME PHYSICAL PROPERTIES IN ALLUVIAL SOILS OF ARID AND SEMI-ARID REGIONS,
W69-06515 02G

SOIL SURVEYS
SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

SOIL TEXTURE
SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD,
W69-06528 02G

SOIL WATER
TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
W69-06516 02G

SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD,
W69-06528 02G

EXTENDED TECHNIQUES OF CALCULATION OF SOIL-WATER MOVEMENT, WITH SOME PHYSICAL CONSEQUENCES,
W69-06714 02G

SOIL WATER MOVEMENT
THEORY OF SOIL MOISTURE - VOL 1, MOISTURE PROPERTIES OF SOILS AND MOVEMENT OF SOIL MOISTURE,
W69-06489 02G

EXTENDED TECHNIQUES OF CALCULATION OF SOIL-WATER MOVEMENT, WITH SOME PHYSICAL CONSEQUENCES,
W69-06714 02G

SOILS
SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

SOIL-WATER-PLANT RELATIONSHIPS
A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

SOLAR RADIATION
WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
W69-06756 03F

SOLID WASTES
DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
W69-06675 05G

SOLVENT EXTRACTION
RECOVERY OF SALTS FROM SALINE WATER VIA SOLVENT EXTRACTION (FINAL REPORT),
W69-06839 03A

SOUTH AFRICA
OPERATION OF MULTI-UNIT MULTI-PURPOSE WATER DEVELOPMENT SYSTEMS,
W69-06462 06D

SOUTH DAKOTA
GEOLOGY AND HYDROLOGY OF CLAY COUNTY SOUTH DAKOTA-PART 1, GEOLOGY, AND PART 2, WATER RESOURCES,
W69-06486 02F

SPARK GAPS
OPEN BREAKER PROTECTION OF EHV SYSTEMS,
W69-06688 08C

SPECIES DIVERSITY
SPECIES DIVERSITY AND COMMUNITY STRUCTURE IN LACUSTRINE PHYTOPLANKTON,
W69-06542 02H

SPECIFICATION ANALYSIS
SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
W69-06567 06A

SPECIFICATIONS
SPECIFICATION AND ESTIMATION OF COBB-DOUGLAS PRODUCTION FUNCTION MODELS,
W69-06560 06A

SPILLWAYS
COMPUTATION OF PRESSURES AND VELOCITIES IN THE CURVILINEAR ZONE OF PRESSURE SPILLWAYS, FOR PREDICTING CAVITATION,
W69-06713 08B

SPRINGS
INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO,
W69-06427 02E

SPRINKLER IRRIGATION
MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
W69-06454 03F

STABILITY
CIRCULAR AND LOGARITHMIC SPIRAL SLIP SURFACES,
W69-06694 08D

STABILITY ANALYSIS
CIRCULAR AND LOGARITHMIC SPIRAL SLIP SURFACES,
W69-06694 08D

STABLE ISOTOPES
THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
W69-06811 07B

STAGE-DISCHARGE RELATIONS
FLOOD INUNDATION AND EFFECTS OF URBANIZATION IN METROPOLITAN CHARLOTTE, NORTH CAROLINA,
W69-06445 04C

STATE GOVERNMENTS
CONSERVATION'S CHALLENGE TO STATE GOVERNMENTS,
W69-06586 06E

STATISTICAL ANALYSIS
ON THE DISTRIBUTION OF STATISTICS SUITABLE FOR EVALUATING RAINFALL STIMULATION EXPERIMENTS,
W69-06679 03B

STATISTICAL MECHANICS
INTERMOLECULAR FORCES AND THE LIQUID STATE,
W69-06838 01A

STATISTICAL METHODS
A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
W69-06680 02E

RANDOM PROCESSES AND LITHOLOGIC TRANSITIONS,
W69-06807 02J

STOCHASTIC PROCESSES
EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
W69-06789 02A

STOMATA
THE HYDROLOGIC IMPORTANCE OF TRANSPIRATION CONTROL BY STOMATA,
W69-06520 02D

STORM RUNOFF
COX V MARTIN (DISCHARGE OF SURFACE WATER THROUGH A DOWNSPOUT).

W69-06596 06E

GIBSON V STATE (CONSTRUCTION AND MAINTENANCE OF SEWERS).
W69-06607 06E

A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

STRATIFICATION
COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
W69-06798 02L

STRATIGRAPHY
COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
W69-06798 02L

RANDOM PROCESSES AND LITHOLOGIC TRANSITIONS,
W69-06807 02J

STREAM GAGES
RESPONSE OF BUBBLE-GAGE SERVOMANOMETERS TO OSCILLATIONS IN WATER LEVEL,
W69-06434 07C

STREAMFLOW
EXTENSIONS OF STREAMFLOW RECORDS IN UTAH,
W69-06447 02E

STREAMFLOW FORECASTING
RELATION OF A HYDROLOGIC INDEX TO MEAN ANNUAL FLOW,
W69-06441 02B

STREAMS
COLEMAN V SCHAEFFER (OBSTRUCTION TO NAVIGABLE STREAM).
W69-06584 06E

BALL CREEK COAL CO V NAPIER (MEANDERS AS A BOUNDARY).
W69-06614 06E

ADKINS V HUGHES (BOUNDARY DISPUTE DUE TO AVULSION).
W69-06658 06E

STRESS ANALYSIS
DETERMINATION OF STRESSES IN THE ARCH OF LARGE UNDERGROUND STRUCTURES, APPEARING AT THE TIME OF EXCAVATION OF THE CORE,
W69-06706 08E

SUBHUMID CLIMATES
SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
W69-06524 02G

SUBSIDENCE
HORIZONTAL MOVEMENTS RELATED TO SUBSIDENCE,
W69-06692 08D

EFFECT OF SUBSIDENCE ON WELL FIELDS,
W69-06763 04B

SUBSOIL
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

SUBSTATIONS(ELECTRICAL)
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

500-KV AC SUBSTATION DESIGN CRITERIA--SUMMARY OF INDUSTRY PRACTICES,
W69-06686 08C

SUBSURFACE DRAINAGE
DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
W69-06512 02G

POTEETE V CITY OF WATER VALLEY (ARTIFICIAL CONTROL OF SUBSURFACE DRAINAGE).
W69-06626 06E

SUBSURFACE WATERS
GEORGE V STATE (OBSTRUCTION OF SUBSURFACE FLOW).
W69-06590 06E

SUDAN
WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
W69-06756 03F

SUL-RISUL(T)
SUL-RISUL(T) ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W69-06836 03A

SURFACE DRAINAGE
BARBER PURE MILK CO V GOLDIN (SURFACE DRAINAGE).
W69-06588 06E

SBARRA V ERIE RR (DRAINAGE OF SURFACE WATERS AND PRESCRIPTIVE RIGHTS).
W69-06591 06E

NASSAU COUNTY V CHERRY VALLEY ESTATES, INC (OBSTRUCTION OF ALLEGED WATER COURSE).
W69-06592 06E

CANNON V CITY OF MACON (NATURAL DRAINAGE FLOW AND THE LOWER LAND PROPRIETOR).
W69-06595 06E

DRAPER V MOSHIER (INTERFERENCE WITH DRAINAGE DITCH).
W69-06600 06E

HANCOCK V STULL (INTERFERENCE WITH NATURAL DRAINAGE OF SURFACE WATER).
W69-06652 06E

NASSAU COUNTY V CHERRY VALLEY ESTATES (LANDOWNERS RIGHT TO PREVENT FLOW OF SURFACE WATER ONTO HIS PROPERTY).
W69-06653 06E

SURFACE FLOWS
PLANNING AND DEVELOPMENT OF WATER RESOURCES IN INDIA,
W69-06728 06B

SURFACE RUNOFF
CLEMENTS V TOWN OF CARROLLTON (DAM ACROSS DRAINAGE DITCH).
W69-06627 06E

RINZLER V POLSOM (ARTIFICIAL INCREASE OF SURFACE RUNOFF).
W69-06657 06E

A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

SURFACE SEALING
FIELD OBSERVATIONS OF SOME PHYSICAL PROPERTIES IN ALLUVIAL SOILS OF ARID AND SEMI-ARID REGIONS,
W69-06515 02G

SURFACE TREATMENT
A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

SURFACE WATERS
WATER-RESOURCES APPRAISAL OF THE LOWER MOAPA-LAKE MEAD AREA, CLARK COUNTY, NEVADA,
W69-06435 02F

FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-III. A STUDY OF PHENOL CONTENT IN SURFACE WATERS,
W69-06444 05A

WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
W69-06451 02E

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

FIELD OBSERVATIONS OF SOME PHYSICAL PROPERTIES IN ALLUVIAL SOILS OF ARID AND SEMI-ARID REGIONS,
W69-06515 02G

SAMYN V TACEY (ARTIFICIAL DRAINAGE OF SURFACE WATERS).
W69-06593 06E

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
W69-06815 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
W69-06816 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
W69-06817 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
W69-06818 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
W69-06819 02F

SURFACE-GROUNDWATER RELATIONSHIPS
PRECIPITATION AND BASE FLOW VARIABILITY,
W69-06443 02B

CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
W69-06796 03F

SURFACTANTS
TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

SURVEYING
COMPUTER-AIRPLANE COMBO SAVES QUARTER MILLION DOLLARS ON SURVEYS AND ADMINISTRATION OF CONSTRUCTION CONTRACTS,
W69-06697 07B

SURVEYS
GROUND WATER, GRAVITY AND RIFT VALLEYS IN MALAWI,
W69-06431 02F

SUSQUEHANNA RIVER BASIN
RELATION OF A HYDROLOGIC INDEX TO MEAN ANNUAL FLOW,
W69-06441 02B

SWELLING
PREDICTION OF SWELLING PRESSURE OF CLAYS,
W69-06693 08D

SWELLING PRESSURES
PREDICTION OF SWELLING PRESSURE OF CLAYS,

W69-06693 08D

SWIMMING
ICE DEALERS BATHING WATER SUPPLY FOR RURAL FIRE PROTECTION.
W69-06631 06E

SWITCHING
SHUNT CAPACITOR ENERGIZATION WITH VACUUM INTERRUPTERS--A POSSIBLE SOURCE OF OVERVOLTAGE,
W69-06689 08C

SWITCHING SURGES
OPEN BREAKER PROTECTION OF EHV SYSTEMS,
W69-06688 08C

SWITCHYARDS(ELECTRICAL)
ELECTRICAL FEATURES OF THE GRAND COULEE THIRD POWER PLANT,
W69-06684 08C

SYNOPTIC ANALYSIS
CLIMATOLOGY STUDIES OF BAFFIN ISLAND, NORTHWEST TERRITORIES,
W69-06814 02B

SYNTHETIC HYDROLOGY
EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
W69-06789 02A

SYSTEMS ANALYSIS
SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
W69-06424 06A

HYDROLOGIC CYCLE AS A CLOSED SYSTEM,
W69-06442 02A

CIVIL ENGINEERING AND URBAN SYSTEMS,
W69-06491 06A

SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE.
W69-06494 04A

SIMULATION OF AN AQUATIC ECOSYSTEM,
W69-06536 02H

HEC-3, RESERVIOR SYSTEM ANALYSIS.
W69-06788 04A

ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
W69-06813 02F

QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
W69-06822 02A

SYSTEMS APPROACH FOR INTEGRATING GROUND WATER AND SURFACE WATER USE.
W69-06834 06A

TACONITE MINING
EMINENT DOMAIN.
W69-06642 06E

TAILINGS
DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
W69-06675 05G

TAXATION
CARNASION V PAUL (RIGHT OF A COUNTY TO TAX TIDELAND PROPERTY).
W69-06644 06E

TEMPERATURE
A TEMPERATURE PROFILE THROUGH THE MEIGHEN ICE CAP, ARCTIC CANADA,
W69-06482 02C

TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

TENNESSEE
STREAM POLLUTION CONTROL IN THE UPPER CUMBERLAND RIVER BASIN 1965.
W69-06488 05G

DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
W69-06785 05B

TERTIARY TREATMENT
RECLAIMED WASTE WATER IN LAS VEGAS VALLEY,
W69-06832 05D

TEST HOLES
RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
W69-06820 02F

TEST PROCEDURES
TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH VOLTAGE INSULATORS.
W69-06708 08C

TEST RESULTS
TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH VOLTAGE INSULATORS.
W69-06708 08C

TEXAS
ARTIFICIAL RECHARGE TO THE EDWARDS LIMESTONE AQUIFER IN SOUTH TEXAS,
W69-06483 04B

THE POTENTIAL CONTRIBUTION OF DESALTING TO FUTURE WATER SUPPLY IN TEXAS.
W69-06558 03A

MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
W69-06559 03A

WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1966-SEPTEMBER 1967,
W69-06786 02H

WATER FOR TEXAS,
W69-06790 06B

THERMAL EXPANSION
TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

THERMAL STRESS
THERMAL STRESS CONDITION OF EXPERIMENTAL LONG BLOCKS DURING CONSTRUCTION PERIOD OF THE BRATSK HYDROELECTRIC STATION DAM,
W69-06711 08F

THYRISTORS
SOME ASPECTS OF INSULATION CO-ORDINATION IN HVDC SYSTEMS,
W69-06707 08C

TIDAL EFFECTS
LEONARD V STATE HIGHWAY DEPT (ACQUISITION OF TITLE BY STATE THROUGH PERMANENT FLOODING OF LAND).
W69-06611 06E

TIDAL WATERS
BAILEY V DRISCOLL (IMPLIED LIMITATION ON GRANT OF SUBMERGED LAND).
W69-06618 06E

TIDELANDS
CARNASION V PAUL (RIGHT OF A COUNTY TO TAX TIDELAND PROPERTY).
W69-06644 06E

TILE DRAINAGE
PROCEEDINGS OF TILE DRAINAGE RESEARCH CONFERENCE,
W69-06795 04A

TILES
DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
W69-06512 02G

TIME SERIES ANALYSIS
EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
W69-06789 02A

TIME SERIES DATA
THE USE OF ERROR COMPONENTS MODELS IN COMBINING CROSS SECTION WITH TIME SERIES DATA,
W69-06552 06A

TOPOGRAPHY
ESTIMATION OF RAINFALL IN SPARSELY GAUGED AREAS,
W69-06773 02B

TORSIONAL VIBRATIONS
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
W69-06698 08C

TRACERS
USE OF TRACER TECHNIQUE IN SOIL EROSION RESEARCH,
W69-06704 04D

TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
W69-06774 07B

TRANSDUCERS
MEASUREMENT OF ROTATING MACHINERY VIBRATION AND FACTORS AFFECTING INSTRUMENT ACCURACY,
W69-06702 07B

TRANSIENTS
PRESSURE TRANSIENTS IN HYDRAULIC PIPELINES,
W69-06700 08A

TRANSMISSION LINES
BROWN BOVERI DISTANCE PROTECTION SYSTEMS EMPLOYING CARRIER TRANSFER,
W69-06709 08C

DISTANCE PROTECTION OF HIGH-VOLTAGE LINES CONTAINING SERIES CAPACITORS,
W69-06710 08C

TRANSMISSION(ELECTRICAL)
A SWING RELAY FOR THE EAST-WEST INTERTIE,
W69-06687 08C

TRANSPIRATION
DYNAMIC SIMULATION MODEL OF THE TRANSPIRATION PROCESS,

W69-06504 02D

TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
W69-06526 02D

TRANSPIRATION CONTROL
THE HYDROLOGIC IMPORTANCE OF TRANSPIRATION CONTROL BY STOMATA,
W69-06520 02D

TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

TREND
SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS,
W69-06569 06A

TREND SURFACE ANALYSIS
TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A CARBONATE BEACH, BIMINI, BWI,
W69-06809 02L

TRIAXIAL COMPRESSION
BRITTLE ROCK FAILURE UNDER TRIAXIAL STRESS,
W69-06701 08E

TRIAXIAL SHEAR
BRITTLE ROCK FAILURE UNDER TRIAXIAL STRESS,
W69-06701 08E

TROPICAL CYCLONES
FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL, U.S. COASTAL REGION, GULF OF MEXICO,
W69-06797 02B

TROPICAL REGIONS
PREDICTION OF RAINSPLASH EROSION IN THE SEASONALLY WET TROPICS,
W69-06768 02J

TUCKER ACT
FONADELLAS V UNITED STATES (TEMPORARY TAKING OF PROPERTY FOR PUBLIC PURPOSE).
W69-06622 06E

TUG BOATS
SOUTHERN TRANSPORTATION CO V CITY OF NEW YORK (NEGLIGENCE OF BRIDGE OPERATOR AND TUG MASTER CAUSING BARGE COLLISION).
W69-06638 06E

TWO-STAGE LEAST SQUARES
SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
W69-06567 06A

UNDERGROUND CORROSION
INNOVATIONS AND THE FUTURE OF CATHODIC PROTECTION,
W69-06677 08A

UNDERGROUND POWERPLANTS
DETERMINATION OF STRESSES IN THE ARCH OF LARGE UNDERGROUND STRUCTURES, APPEARING AT THE TIME OF EXCAVATION OF THE CORE,
W69-06706 08E

UNDERGROUND STRUCTURES
DETERMINATION OF STRESSES IN THE ARCH OF LARGE UNDERGROUND STRUCTURES, APPEARING AT THE TIME OF EXCAVATION OF THE CORE,
W69-06706 08E

UNITED ARAB REPUBLIC
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

UNITED NATIONS
THE ROLE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IN THE DEVELOPMENT, USE AND CONTROL OF WATER RESOURCES.
W69-06456 03A

UNITED STATES
KANSAS CITY LIFE INS CO V UNITED STATES (IMPAIRMENT OF LAND VALUE DUE TO DAM CONSTRUCTION).
W69-06623 06E

URBAN HYDROLOGY
AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
W69-06770 04C

URBAN WATER USE
WATER RESOURCES AND THE URBAN ENVIRONMENT,
W69-06428 04C

URBANIZATION
WATER RESOURCES AND THE URBAN ENVIRONMENT,
W69-06428 04C

FLOOD INUNDATION AND EFFECTS OF URBANIZATION IN METROPOLITAN CHARLOTTE, NORTH CAROLINA,
W69-06445 04C

CIVIL ENGINEERING AND URBAN SYSTEMS,
W69-06491 06A

FORECASTING URBAN WATER DEMANDS IN DEVELOPING COUNTRIES,
W69-06727 06D

WATER POLLUTION CONTROL,
W69-06731 05G

AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
W69-06770 04C

USSR
THEORY OF SOIL MOISTURE - VOL 1, MOISTURE PROPERTIES OF SOILS AND MOVEMENT OF SOIL MOISTURE,
W69-06489 02G

DYNAMICS OF CHANNEL FLOW,
W69-06835 02E

UTAH
EXTENSIONS OF STREAMFLOW RECORDS IN UTAH,
W69-06447 02E

VALUE
COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
W69-06733 06B

VEGETATION
POTENTIAL OF RADAR REMOTE SENSORS AS TOOLS IN RECONNAISSANCE GEOMORPHIC, VEGETATION AND SOIL MAPPING,
W69-06718 07B

VERMONT
GROUND WATER FAVORABILITY MAP OF THE OTTAUQUECHEE-SAXTONS RIVER BASIN, VERMONT,
W69-06463 02F

GROUND WATER FAVORABILITY MAP OF THE WEST-DEERFIELD RIVER BASIN, VERMONT,
W69-06464 02F

GROUND WATER FAVORABILITY MAP OF THE WELLS-OMPOMPANOOSUC RIVER BASIN, VERMONT,
W69-06465 02F

GROUND WATER FAVORABILITY MAP OF THE WHITE RIVER BASIN, VERMONT,
W69-06466 02F

VIBRATIONS
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
W69-06698 08C

MEASUREMENT OF ROTATING MACHINERY VIBRATION AND FACTORS AFFECTING INSTRUMENT ACCURACY,
W69-06702 07B

VIRGINIA
CITY OF PORTSMOUTH V CULPEPPER (SUIT FOR DAMAGES RESULTING FROM OVERFLOW OF OBSTRUCTED CANAL).
W69-06602 06E

CHESAPEAKE BAY CASE STUDY.
W69-06794 06B

VOLUME CHANGE
TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

VON BERTALANFFY CURVES
A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
W69-06533 05C

WASHINGTON
FLOOD PLAIN INFORMATION, WALLA WALLA RIVER TRIBUTARIES IN THE VICINITY OF WALLA WALLA, WASHINGTON.
W69-06469 04A

FLOOD PLAIN INFORMATION, YAKIMA RIVER, BENTON COUNTY, WASHINGTON.
W69-06470 04A

WASTE DISPOSAL
ROLE OF GROUND WATER CONTAMINATION IN WATER MANAGMENT,
W69-06762 05G

WASTE TREATMENT
WATER SUPPLY AND WASTEWATER TREATMENT PROBLEMS OF INDUSTRIAL AND TRADE ENTERPRISES,
W69-06723 05D

22 ND INDUSTRIAL WASTE CONFERENCE, 1967, PART ONE,
W69-06821 05D

WATER ALLOCATION(POLICY)
CONFERENCE ON WATER DECISIONS IN THE CRITICAL 1960'S,
W69-06572 06B

THE COMPETITION FOR WATER QUANTITY AGRICULTURE,
W69-06575 06D

THE COMPETITION FOR WATER QUANTITY INDUSTRY,
W69-06577 06D

ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

WATER BALANCE
PRINCIPLES OF CHOOSING EXPERIMENTAL PLOTS FOR WATER BALANCE STUDIES IN IRRIGATION REGIONS OF THE ARID ZONE,
W69-06523 02G

THE GENERAL WATER SCHEME - AN ESSENTIAL BASIS FOR THE MOST RATIONAL USE OF WATER RESOURCES,
W69-06724 06B

WATER CHEMISTRY
FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-III. A STUDY OF PHENOL CONTENT IN SURFACE WATERS,
W69-06444 05A

GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

WATER CIRCULATION
HYDROLOGIC CYCLE AS A CLOSED SYSTEM,
W69-06442 02A

SOME DETAILS ON THE CIRCULATION OF GROUNDWATER IN NON-KARSTIFIED FISSURED FORMATIONS IN CZECHOSLOVAKIA (FRENCH),
W69-06485 02F

WATER CONSERVATION
IRRIGATION WATER SYSTEM--ISRAEL'S NATIONAL WATER GRID,
W69-06459 03F

WATER COST
THE STATUS OF SEA WATER CONVERSION,
W69-06583 03A

WATER COSTS
DESALTED SEAWATER FOR AGRICULTURE IS IT ECONOMIC,
W69-06765 03F

WATER DEMAND
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W69-06502 06D

THE COMPETITION FOR WATER QUANTITY,
W69-06574 06D

FORECASTING URBAN WATER DEMANDS IN DEVELOPING COUNTRIES,
W69-06727 06D

WATER DISTRIBUTION(APPLIED)
OPERATION OF MULTI-UNIT MULTI-PURPOSE WATER DEVELOPMENT SYSTEMS,
W69-06462 06D

USE OF DIGITAL COMPUTERS IN DISTRIBUTION SYSTEM ANALYSES,
W69-06503 07C

WATER DISTRICTS
WATER SUPPLY DISTRICTS.
W69-06630 06E

WATER EQUIVALENT
A UNIVERSAL SURFACE PRECIPITATION GAGE,
W69-06804 02B

WATER HAMMER
PRESSURE TRANSIENTS IN HYDRAULIC PIPELINES,
W69-06700 08A

WATER HARVESTING
A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

WATER LAW
WATER LAWS AND CONCEPTS,
W69-06683 06E

WATER MANAGEMENT
THE GENERAL WATER SCHEME - AN ESSENTIAL BASIS FOR THE MOST RATIONAL USE OF WATER RESOURCES,
W69-06724 06B

SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
W69-06725 06B

WATER MANAGEMENT(APPLIED)
SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
W69-06424 06A

WATER RESOURCES AND THE URBAN ENVIRONMENT,
W69-06428 04C

MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
W69-06454 03F

IRRIGATION WATER SYSTEM--ISRAEL'S NATIONAL WATER GRID,
W69-06459 03F

SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE.
W69-06494 04A

WATER QUALITY MANAGEMENT ENGINEERING-ECONOMIC FACTORS IN MUNICIPAL WASTE DISPOSAL,
W69-06505 05D

THE COMPETITION FOR WATER QUANTITY INDUSTRY,
W69-06577 06D

WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF ENGINEERS IN COLORADO.
W69-06782 09D

WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF ENGINEERS IN DELAWARE.
W69-06783 09D

WATER RESOURCES DEVELOPMENT IN MINNESOTA.
W69-06784 09D

WATER POLICY
CONFERENCE ON WATER DECISIONS IN THE CRITICAL 1960'S,
W69-06572 06B

ROLE OF GROUND WATER CONTAMINATION IN WATER MANAGMENT,
W69-06762 05G

CHESAPEAKE BAY CASE STUDY.
W69-06794 06B

WATER POLLUTION
EFFECTS OF MINE DRAINAGE ON GROUND WATER,
W69-06425 05C

MICROBIAL PROBLEMS IN GROUNDWATER,
W69-06426 05C

ROLE OF GROUND WATER CONTAMINATION IN WATER MANAGMENT,
W69-06762 05G

POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
W69-06802 05B

WATER POLLUTION CONTROL
STREAM POLLUTION CONTROL IN THE UPPER CUMBERLAND RIVER BASIN 1965.
W69-06488 05G

ECONOMIC FRAMEWORK FOR SALINITY CONTROL PROJECTS,
W69-06490 05D

SEWERAGE DISTRICTS AND BOARDS.
W69-06632 05G

WATER POLLUTION CONTROL,
W69-06731 05G

POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
W69-06802 05B

WATER POLLUTION TREATMENT
STREAM POLLUTION CONTROL IN THE UPPER CUMBERLAND RIVER BASIN 1965.
W69-06488 05G

OIL AND HAZARDOUS MATERIALS-EMERGENCY PROCEDURES IN THE WATER ENVIRONMENT.
W69-06791 05G

POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
W69-06802 05B

WATER POTENTIAL
A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

WATER PROPERTIES
ECONOMIC EFFECTS OF MINERAL CONTENT IN MUNICIPAL WATER SUPPLIES.
W69-06555 03A

WATER QUALITY
THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
W69-06547 05F

SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
W69-06725 06B

WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1966-SEPTEMBER 1967,
W69-06786 02H

CHESAPEAKE BAY CASE STUDY.
W69-06794 06B

WATER QUALITY CONTROL
WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
W69-06499 05G

STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
W69-06500 05B

WATER QUALITY MANAGEMENT ENGINEERING-ECONOMIC FACTORS IN MUNICIPAL WASTE DISPOSAL,
W69-06505 05D

WATER QUALITY MANAGEMENT
THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
W69-06547 05F

WATER RESOURCE DEPENDENCIES
INTERREGIONAL PRODUCTION AND WATER RESOURCE DEPENDENCIES AMONG THE WESTERN STATES,
W69-06721 06B

WATER RESOURCE DEVELOPMENT
LEGAL ALTERNATIVES,
W69-06579 06E

THE LEGISLATIVE POINT OF VIEW,
W69-06580 06E

WATER RESOURCES
WATER-RESOURCES APPRAISAL OF THE LOWER MOAPA-LAKE MEAD AREA, CLARK COUNTY, NEVADA,
W69-06435 02F

SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

GEOLOGY AND GROUND-WATER RESOURCES OF BURLINGTON COUNTY, NEW JERSEY,
W69-06449 02F

GEOLOGY AND GROUND-WATER RESOURCES OF THE RAHWAY AREA, NEW JERSEY,
W69-06450 02F

WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
W69-06451 02E

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

GROUND WATER FAVORABILITY MAP OF THE OTTAUQUECHEE-SAXTONS RIVER BASIN, VERMONT,
W69-06463 02F

GROUND WATER FAVORABILITY MAP OF THE WEST-DEERFIELD RIVER BASIN, VERMONT,
W69-06464 02F

GROUND WATER FAVORABILITY MAP OF THE WELLS-OMPOMPANOOSUC RIVER BASIN, VERMONT,
W69-06465 02F

GROUND WATER FAVORABILITY MAP OF THE WHITE RIVER BASIN, VERMONT,
W69-06466 02F

GEOLOGY AND HYDROLOGY OF CLAY COUNTY SOUTH DAKOTA-PART 1, GEOLOGY, AND PART 2, WATER RESOURCES,
W69-06486 02F

PERMUTED TITLE INDEX TO WATER RESEARCH JOURNALS, 1967.
W69-06539 10

CONSERVATION'S CHALLENGE TO STATE GOVERNMENTS,
W69-06586 06E

ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

THE GENERAL WATER SCHEME - AN ESSENTIAL BASIS FOR THE MOST RATIONAL USE OF WATER RESOURCES,
W69-06724 06B

CHOOSING AMONG ALTERNATIVE PUBLIC INVESTMENTS IN THE WATER RESOURCE FIELD,
W69-06740 06B

WATER RESOURCES DEVELOPMENT IN MINNESOTA.
W69-06784 09D

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
W69-06815 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
W69-06816 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
W69-06817 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
W69-06818 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
W69-06819 02F

SYSTEMS APPROACH FOR INTEGRATING GROUND WATER AND SURFACE WATER USE.
W69-06834 06A

WATER RESOURCES COUNCIL
INTERGOVERNMENTAL PLANNING OF WATER RESOURCES,
W69-06429 06B

WATER RESOURCES DEVELOPMENT
A SIMPLIFIED TECHNIQUE FOR WELL-FIELD DESIGN,
W69-06421 02F

WATER RESOURCES AND THE URBAN ENVIRONMENT,
W69-06428 04C

INTERGOVERNMENTAL PLANNING OF WATER RESOURCES,
W69-06429 06B

RURAL WATER DEVELOPMENT IN KENYA,
W69-06453 04A

THE ROLE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IN THE DEVELOPMENT, USE AND CONTROL OF WATER RESOURCES.
W69-06456 03A

AGRICULTURE USE OF WATER IN TAIWAN, REPUBLIC OF CHINA,
W69-06460 03F

OPERATION OF MULTI-UNIT MULTI-PURPOSE WATER DEVELOPMENT SYSTEMS,
W69-06462 06D

SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE.
W69-06494 04A

ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

PLANNING AND DEVELOPMENT OF WATER RESOURCES IN INDIA,
W69-06728 06B

KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF ENGINEERS IN COLORADO.
W69-06782 09D

WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF ENGINEERS IN DELAWARE.
W69-06783 09D

WATER FOR TEXAS,
W69-06790 06B

WATER RESOURCES PLANNING
REGIONAL PLANNING FOR WATER DEVELOPMENT IN THE WESTERN UNITED STATES - THE RELEVANCE OF AMERICAN EXPERIENCE FOR OTHER NATIONS,
W69-06726 06B

WATER REUSE
22 ND INDUSTRIAL WASTE CONFERENCE, 1967, PART ONE,
W69-06821 05D

RECLAIMED WASTE WATER IN LAS VEGAS VALLEY,
W69-06832 05D

WATER RIGHTS
WATER LAWS AND CONCEPTS,
W69-06683 08E

WATER SHORTAGE
DROUGHT IN THE NORTHEASTERN UNITED STATES,
W69-06436 02B

EFFECTS OF THE DROUGHT ON WATER RESOURCES-SURFACE AND SUBSURFACE HYDROLOGY,
W69-06440 02B

WATER SUPPLY
ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
W69-06509 02F

THE COMPETITION FOR WATER QUANTITY INDUSTRY,
W69-06577 06D

FIRES.
W69-06598 06E

WATER SUPPLY DISTRICTS.
W69-06630 06E

WATER SUPPLY AND WASTEWATER TREATMENT PROBLEMS OF INDUSTRIAL AND TRADE ENTERPRISES,
W69-06723 05D

REGIONAL PLANNING FOR WATER DEVELOPMENT IN THE WESTERN UNITED STATES - THE RELEVANCE OF AMERICAN EXPERIENCE FOR OTHER NATIONS,
W69-06726 06B

ROLE OF GROUND WATER CONTAMINATION IN WATER MANAGMENT,
W69-06762 05G

SYSTEMS APPROACH FOR INTEGRATING GROUND WATER AND SURFACE WATER USE.
W69-06834 06A

WATER SURFACE PROFILES
HEC-2, WATER SURFACE PROFILES.
W69-06787 04A

WATER TABLE
THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
W69-06758 02F

WATER TRANSPORTATION
WATER TRANSPORTATION-IMPACT ON ECONOMIC DEVELOPMENT,
W69-06730 06B

WATER UTILIZATION
ESTIMATED WATER USE IN NEVADA, 1950-65,
W69-06446 06D

EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,

W69-06511 03F

WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
W69-06756 03F

CHESAPEAKE BAY CASE STUDY.
W69-06794 06B

SYSTEMS APPROACH FOR INTEGRATING GROUND WATER AND SURFACE WATER USE.
W69-06834 06A

WATER WELLS
A DESIGN METHOD FOR DEEP WELL DEWATERING INSTALLATIONS,
W69-06430 02F

GEOLOGY, DESIGN, AND CONSTRUCTION OF DEEP WELLS IN SEDIMENTARY FOUNDATIONS,
W69-06759 02F

A RIGID PLATE MODEL OF THE BAROMETRIC EFFECT,
W69-06775 02F

WATER YIELD
SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

GEOLOGY AND GROUND-WATER RESOURCES OF THE RAHWAY AREA, NEW JERSEY,
W69-06450 02F

GROUND WATER FAVORABILITY MAP OF THE OTTAUQUECHEE-SAXTONS RIVER BASIN, VERMONT,
W69-06463 02F

GROUND WATER FAVORABILITY MAP OF THE WEST-DEERFIELD RIVER BASIN, VERMONT,
W69-06464 02F

GROUND WATER FAVORABILITY MAP OF THE WELLS-OMPOMPANOOSUC RIVER BASIN, VERMONT,
W69-06465 02F

GROUND WATER FAVORABILITY MAP OF THE WHITE RIVER BASIN, VERMONT,
W69-06466 02F

WATER YIELD IMPROVEMENT
THE HYDROLOGIC IMPORTANCE OF TRANSPIRATION CONTROL BY STOMATA,
W69-06520 02D

A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

WATERWORKS
WHITE OAK BOROUGH AUTH V PENN PUB U COMM'N (AQUISITION OF PUBLIC WATER FACILITIES).
W69-06601 06E

WEATHER DATA
EVALUATION OF SOME PRACTICAL METHODS OF ESTIMATING EVAPOTRANSPIRATION IN ARID CLIMATES AT LOW LATITUDES,
W69-06530 02D

WEATHER MODIFICATION
ON THE DISTRIBUTION OF STATISTICS SUITABLE FOR EVALUATING RAINFALL STIMULATION EXPERIMENTS,
W69-06679 03B

REGIONAL HYDROLOGIC AREA STUDY AS AN ANALYSIS TOOL IN WEATHER MODIFICATION,
W69-06385 02A

WELFARE(ECONOMICS)
PUBLIC UTILITY PRICING AND OUTPUT UNDER RISK,
W69-06549 06C

WELL SPACING
A SIMPLIFIED TECHNIQUE FOR WELL-FIELD DESIGN,
W69-06421 02F

WELLS
STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

GEOLOGY, DESIGN, AND CONSTRUCTION OF DEEP WELLS IN SEDIMENTARY FOUNDATIONS,
W69-06759 02F

EFFECT OF SUBSIDENCE ON WELL FIELDS,
W69-06763 04B

RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
W69-06820 02F

WELL-FIELD DESIGN
A SIMPLIFIED TECHNIQUE FOR WELL-FIELD DESIGN,
W69-06421 02F

WEST VIRGINIA
FLOOD WALL BOARD.
W69-06647 06E

WESTERN STATES
INTERREGIONAL PRODUCTION AND WATER RESOURCE DEPENDENCIES AMONG THE WESTERN STATES,
W69-06721 06B

WESTERN UNITED STATES
REGIONAL PLANNING FOR WATER DEVELOPMENT IN THE WESTERN UNITED STATES - THE RELEVANCE OF AMERICAN EXPERIENCE FOR OTHER NATIONS,
W69-06726 06B

WHEAT
EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
W69-06511 03F

WILDLIFE
JURISDICTION OVER WATERS.
W69-06634 06E

WILTING POINT
TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
W69-06516 02G

WISCONSIN
PRECIPITATION AND BASE FLOW VARIABILITY,
W69-06443 02B

ZOMBKOWSKI V WISCONSIN RIVER POWER CO (FLOODING DAMAGES CAUSED BY DAM CONSTRUCTION).
W69-06603 06E

SKALITSKY V CONSOL BADGER CO-OPERATIVE (OWNERSHIP OF FILLED POND BED).
W69-06650 06E

WITHDRAWAL
ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
W69-06509 02F

WORLD HEALTH ORGANIZATION
WATER POLLUTION CONTROL,
W69-06731 05G

YAQUINA RIVER
SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
W69-06725 06B

YUGOSLAVIA
A CONTRIBUTION TO THE STUDY OF GROUNDWATER INTAKE RECHARGE IN KARST,
W69-06484 02F

AUTHOR INDEX

ABD EL RAHMAN, A. A.
TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
W69-06526 02D

AHUJA, P. R.
BENEFICIAL USES OF WATERS OF INTERNATIONAL RIVERS INTERNATIONAL LAW AND PRACTICE,
W69-06458 06E

ALEXANDER, LYLE T.
DESALTED SEAWATER FOR AGRICULTURE IS IT ECONOMIC,
W69-06765 03F

ALLEN, R. R.
DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
W69-06512 02G

ALLISON, STEPHEN V.
COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
W69-06733 06B

AMBROGGI, ROBERT
ARTIFICIAL RECHARGE OF A FISSURED SANDSTONE AQUIFER, TANGIERS, MOROCCO (FRENCH),
W69-06487 04B

AMEMIYA, TAKESHI
SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
W69-06567 06A

ANAND, D. B.
A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
W69-06461 04A

ANDERSON, HENRY R.
GEOLOGY AND GROUND-WATER RESOURCES OF THE RAHWAY AREA, NEW JERSEY,
W69-06450 02F

ANDERSON, PETER W.
FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-III. A STUDY OF PHENOL CONTENT IN SURFACE WATERS,
W69-06444 05A

ANGUS, D. E.
TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

ARMSTRONG, DAVID L.
WATER TRANSPORTATION-IMPACT ON ECONOMIC DEVELOPMENT,
W69-06730 06B

ARRIEL, M.
OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
W69-06495 03A

AVRETT, J. R.
WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
W69-06451 02E

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
W69-06815 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
W69-06816 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
W69-06817 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
W69-06818 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
W69-06819 02F

BAIER, W.
THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

BAILEY, JOHN J.
USE OF DIGITAL COMPUTERS IN DISTRIBUTION SYSTEM ANALYSES,
W69-06503 07C

BAIRD, R. W.
GRADED FURROWS FOR WATER EROSION CONTROL,
W69-06746 02J

BALASUBRAMANIAN, S.
A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
W69-06461 04A

BAPTIST, JOHN V.
ELECTRICAL FEATURES OF THE GRAND COULEE THIRD POWER PLANT,
W69-06684 08C

BARKSDALE, HENRY C.
EFFECTS OF THE DROUGHT ON WATER RESOURCES-SURFACE AND SUBSURFACE HYDROLOGY,
W69-06440 02B

BARRETT, R.
RURAL WATER DEVELOPMENT IN KENYA,
W69-06453 04A

BARRY, R. G.
CLIMATOLOGY STUDIES OF BAFFIN ISLAND, NORTHWEST TERRITORIES,
W69-06814 02B

BATANOUNY, K. H.
TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
W69-06526 02D

BEAMER, J. H.
OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
W69-06495 03A

BEASLEY, T. M.
NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
W69-06766 05A

BEAVER, J. A.
SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
W69-06424 06A

BECK, J. B.
RESPONSE OF BUBBLE-GAGE SERVOMANOMETERS TO OSCILLATIONS IN WATER LEVEL,
W69-06434 07C

BELINSKII, A. S.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
W69-06698 08C

BELL, F. C.
IMPROVED TECHNIQUES FOR ESTIMATING RUNOFF WITH BRIEF RECORDS,
W69-06830 02E

BERGSTROM, A. R.
NONRECURSIVE MODELS AS DISCRETE APPROXIMATIONS TO SYSTEMS OF STOCHASTIC DIFFERENTIAL EQUATIONS,
W69-06571 06A

BERRY, DONALD S.
CIVIL ENGINEERING AND URBAN SYSTEMS,
W69-06491 06A

BERRY, L. M.
500-KV AC SUBSTATION DESIGN CRITERIA--SUMMARY OF INDUSTRY PRACTICES,
W69-06686 08C

BEVERTON, R. J. H.
A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
W69-06533 05C

BHUIYA, REZAUL K.
EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
W69-06789 02A

BIANCHI, W. C.
THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
W69-06758 02F

BIELORAI, H.
TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

BIERWAG, G. O.
AGGREGATE KOYCK FUNCTIONS,
W69-06561 06B

BLAKELY, ROBERT F.
RANDOM PROCESSES AND LITHOLOGIC TRANSITIONS,
W69-06807 02J

BLANCHARD, R. R.
500-KV AC SUBSTATION DESIGN CRITERIA--SUMMARY OF INDUSTRY PRACTICES,
W69-06686 08C

BLOODGOOD, DON E.
22 ND INDUSTRIAL WASTE CONFERENCE, 1967, PART ONE,
W69-06821 05D

BOBCHENKO, V. E.

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W69-06716 03F

BOEHNE, E. W.
SHUNT CAPACITOR ENERGIZATION WITH VACUUM INTERRUPTERS--A POSSIBLE SOURCE OF OVERVOLTAGE,
W69-06689 08C

BOERSMA, L.
DYNAMIC SIMULATION MODEL OF THE TRANSPIRATION PROCESS,
W69-06504 02D

BOON, JOHN D., III.
TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A CARBONATE BEACH, BIMINI, BWI,
W69-06809 02L

BOTTORFF, ALLEN
THE COMPETITION FOR WATER QUANTITY AGRICULTURE,
W69-06575 06D

BOUYOUCOS, GEORGE J.
TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
W69-06516 02G

BRILLINGER, DAVID R.
AN HARMONIC ANALYSIS OF NONSTATIONARY MULTIVARIATE ECONOMIC PROCESSES,
W69-06553 06A

BROWER, DAVID R.
COMMENTS ON THE COMPETITION FOR WATER QUALITY AGRICULTURE,
W69-06576 06D

BROWN, GARDNER
PUBLIC UTILITY PRICING AND OUTPUT UNDER RISK,
W69-06549 06C

BRUINGTON, A. E.
CONTROL OF SEA-WATER INTRUSION IN A GROUND-WATER AQUIFER,
W69-06422 02F

BRUTSAERT, WILFRIED
EVALUATION OF SOME PRACTICAL METHODS OF ESTIMATING EVAPOTRANSPIRATION IN ARID CLIMATES AT LOW LATITUDES,
W69-06530 02D

BRYANT, EDWARD A.
FORECASTING URBAN WATER DEMANDS IN DEVELOPING COUNTRIES,
W69-06727 06D

BUGOV, A. U.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
W69-06698 08C

BUKHARI, S. A.
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

BURKE, HARRIS H.
DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
W69-06675 05G

BUTCHER, WILLIAM S.
QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
W69-06822 02A

BUTTERFIELD, DAVID
GROUND WATER FAVORABILITY MAP OF THE OTTAUQUECHEE-SAXTONS RIVER BASIN, VERMONT,
W69-06463 02F

GROUND WATER FAVORABILITY MAP OF THE WEST-DEERFIELD RIVER BASIN, VERMONT,
W69-06464 02F

GROUND WATER FAVORABILITY MAP OF THE WELLS-OMPOMPANOOSUC RIVER BASIN, VERMONT,
W69-06465 02F

GROUND WATER FAVORABILITY MAP OF THE WHITE RIVER BASIN, VERMONT,
W69-06466 02F

CALANDRO, ANTHONY J.
RAINFALL-RUNOFF RELATIONS FOR SOUTHEASTERN LOUISIANA AND SOUTHWESTERN MISSISSIPPI,
W69-06829 02A

CARROON, L. E.
EXTENSIONS OF STREAMFLOW RECORDS IN UTAH,
W69-06447 02E

CHEN-HSING, LIU
ON THE ESTIMATION OF EVAPORATION FROM A LAND SURFACE,
W69-06833 02D

CHETYRKIN, M. S.
DETERMINATION OF STRESSES IN THE ARCH OF LARGE UNDERGROUND STRUCTURES, APPEARING AT THE TIME OF EXCAVATION OF THE CORE,
W69-06706 08E

CHILDERS, RALPH E.
MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
W69-06559 03A

CHRISTENSEN, CLEO M.
GEOLOGY AND HYDROLOGY OF CLAY COUNTY SOUTH DAKOTA-PART 1, GEOLOGY, AND PART 2, WATER RESOURCES,
W69-06486 02F

CHRISTENSEN, J. J.
A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS PART 1,
W69-06556 03C

CHRISTIANSEN, JERALD E.
ESTIMATING PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
W69-06522 02D

CLARK, GLENN A.
SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

CLASSEN, G.
RURAL WATER DEVELOPMENT IN KENYA,
W69-06453 04A

CLAWSON, MARION
DESALTED SEAWATER FOR AGRICULTURE IS IT ECONOMIC,
W69-06765 03F

CLYMER, A. B.
THE DESIRABILITY AND APPLICABILITY OF SIMULATING ECOSYSTEMS,
W69-06537 06A

COFFEY, PHILIP J.
ECONOMIC FRAMEWORK FOR SALINITY CONTROL PROJECTS,
W69-06490 05D

COOK, RAY L.
TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
W69-06516 02G

COREY, ARTHUR THOMAS
CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
W69-06796 03F

COWAN, W. R.
SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

COX, J. T. H.
THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

COX, LLOYD M.
A UNIVERSAL SURFACE PRECIPITATION GAGE,
W69-06804 02B

CRAFT, B. C.
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

CRAGG, J. G.
ON THE RELATIVE SMALL-SAMPLE PROPERTIES OF SEVERAL STRUCTURAL-EQUATION ESTIMATORS,
W69-06734 06B

DALALY, H.
SUL-BISUL(T) ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W69-06836 03A

DANILIN, A. I.
GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
W69-06811 07B

DARAB, K.
SALT BALANCE AND SALT TRANSPORT PROCESSES IN IRRIGATED SOILS,
W69-06717 03F

DAVIDHAZY, ANDREW
BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
W69-06840 03A

DAVIDSON, HELEN J.
WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1966-SEPTEMBER 1967,
W69-06786 02H

DAVIDSON, R. S.
THE DESIRABILITY AND APPLICABILITY OF SIMULATING ECOSYSTEMS,
W69-06537 06A

DAVID, DAVID
PREDICTION OF SWELLING PRESSURE OF CLAYS,
W69-06693 08D

DAVIS, H. CRAIG
INTERREGIONAL PRODUCTION AND WATER RESOURCE DEPENDENCIES AMONG THE WESTERN STATES,
W69-06721 06B

DAVIS, J. C.
RECOVERY OF SALTS FROM SALINE WATER VIA SOLVENT EXTRACTION (FINAL REPORT),

W69-06839 03A

DAVIS, RICHARD W.
GROUND WATER, GRAVITY AND RIFT VALLEYS IN MALAWI,
W69-06431 02F

DE ALESSI, LOUIS
IMPLICATIONS OF PROPERTY RIGHTS FOR GOVERNMENT INVESTMENT CHOICES,
W69-06548 06B

DE QUERVAIN, M.
DEFORMATION OF POLYCRYSTALLINE ICE UNDER COMBINED UNIAXIAL AND HYDROSTATIC PRESSURE,
W69-06475 02C

DEPREE, D. O.
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W69-06837 03A

DIETRICH, GARY
THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
W69-06547 05F

DOERING, E. J.
SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD,
W69-06528 02G

DOLAN, PAUL R.
500-KV AC SUBSTATION DESIGN CRITERIA--SUMMARY OF INDUSTRY PRACTICES,
W69-06686 08C

DOMINY, FLOYD E.
ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

DOOGE, JAMES C. I.
HYDROLOGIC CYCLE AS A CLOSED SYSTEM,
W69-06442 02A

DRACUP, JOHN A.
ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
W69-06813 02F

QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
W69-06822 02A

DREZE, J.
SPECIFICATION AND ESTIMATION OF COBB-DOUGLAS PRODUCTION FUNCTION MODELS,
W69-06560 06A

DUGAN, H. P.
THE COMPETITION FOR WATER QUANTITY,
W69-06574 06D

DUSEK, D. A.
EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
W69-06511 03F

EAGLESON, PETER S.
STREAMFLOW RECORD LENGTH FOR MODELLING CATCHMENT DYNAMICS,
W69-06781 02E

EIDEL'MAN, S. YA
THERMAL STRESS CONDITION OF EXPERIMENTAL LONG BLOCKS DURING CONSTRUCTION PERIOD OF THE BRATSK HYDROELECTRIC STATION DAM,
W69-06711 08F

EISENPRESS, HARRY
THE ESTIMATION OF NONLINEAR ECONOMETRIC SYSTEMS,
W69-06562 06A

EKSTEIN, J.
GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

EL-ANSARI, A. E.
COMPUTATION OF PRESSURES AND VELOCITIES IN THE CURVILINEAR ZONE OF PRESSURE SPILLWAYS, FOR PREDICTING CAVITATION,
W69-06713 08B

EMRICH, GROVER H.
EFFECTS OF MINE DRAINAGE ON GROUND WATER,
W69-06425 05C

ENGELBERT, ERNEST A.
REGIONAL PLANNING FOR WATER DEVELOPMENT IN THE WESTERN UNITED STATES - THE RELEVANCE OF AMERICAN EXPERIENCE FOR OTHER NATIONS,
W69-06726 06B

ERIKSSON, E.
GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
W69-06811 07B

FAUST, SAMUEL D.
FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXIBENZENE-III. A STUDY OF PHENOL CONTENT IN SURFACE WATERS,
W69-06444 05A

FEDER, PAUL
ON THE DISTRIBUTION OF STATISTICS SUITABLE FOR EVALUATING RAINFALL STIMULATION EXPERIMENTS,
W69-06679 03B

FERNANDEZ, PEDRO
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

FOGARASI, S.
CLIMATOLOGY STUDIES OF BAFFIN ISLAND, NORTHWEST TERRITORIES,
W69-06814 02B

FONG-YIH, LIU
AGRICULTURE USE OF WATER IN TAIWAN, REPUBLIC OF CHINA,
W69-06460 03F

FOSSETTE, CARL
THE COMPETITION FOR WATER QUANTITY INDUSTRY,
W69-06577 06D

FRANKEL, M. L.
SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
W69-06424 06A

FRANKEL, RICHARD J.
WATER QUALITY MANAGEMENT ENGINEERING-ECONOMIC FACTORS IN MUNICIPAL WASTE DISPOSAL,
W69-06505 05D

FREEDMAN, SIDNEY
HX CONCRETE,
W69-06678 08F

FRUH, E. GUS
THE AGING OF LAKES,
W69-06535 02H

FRYREAR, D. W.
GRADED FURROWS FOR WATER EROSION CONTROL,
W69-06746 02J

GABRIEL, K. R.
ON THE DISTRIBUTION OF STATISTICS SUITABLE FOR EVALUATING RAINFALL STIMULATION EXPERIMENTS,
W69-06679 03B

GANTNER, J.
BROWN BOVERI DISTANCE PROTECTION SYSTEMS EMPLOYING CARRIER TRANSFER,
W69-06709 08C

GAT, JOEL R.
THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

GEBHART, LLOYD R.
HIGH EARTHFILL DAM FOUNDATION GROUTING DESIGN AND CONSTRUCTION PROCEDURES,
W69-06674 08D

GEMMELL, ROBERT S.
CIVIL ENGINEERING AND URBAN SYSTEMS,
W69-06491 06A

GIARDINI, A. A.
BRITTLE ROCK FAILURE UNDER TRIAXIAL STRESS,
W69-06701 08E

GILLILAND, J. A.
A RIGID PLATE MODEL OF THE BAROMETRIC EFFECT,
W69-06775 02F

GILL, HAROLD E.
SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

GLEN, J. W.
THE MECHANICAL PROPERTIES OF SINGLE CRYSTALS OF ICE AT LOW TEMPERATURES,
W69-06474 02C

THE IMPORTANCE OF THE HYDROGEN ATOM ARRANGEMENT IN DETERMINING HOW ICE CAN DEFORM PLASTICALLY,
W69-06476 02C

GOLDBERG, DAN
MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
W69-06458 03F

GOLDEN, H. G.
WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
W69-06451 02E

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
W69-06815 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
W69-06817 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
W69-06818 02F

GOLDFELD, STEPHEN M.
MAXIMIZATION BY QUADRATIC HILL-CLIMBING,

W69-06564 06A

GONCHAROV, V. N.
DYNAMICS OF CHANNEL FLOW,
W69-06835 02E

GOODWIN, C. R.
RESPONSE OF BUBBLE-GAGE SERVOMANOMETERS TO OSCILLATIONS IN WATER LEVEL,
W69-06434 07C

GOODYEAR, HUGO V.
FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL, U.S. COASTAL REGION, GULF OF MEXICO,
W69-06797 02B

GRAYMAN, WALTER M.
STREAMFLOW RECORD LENGTH FOR MODELLING CATCHMENT DYNAMICS,
W69-06781 02E

GREENSTADT, JOHN
THE ESTIMATION OF NONLINEAR ECONOMETRIC SYSTEMS,
W69-06562 06A

GREEN, MELVIN G.
ARTIFICIAL RECHARGE TO THE EDWARDS LIMESTONE AQUIFER IN SOUTH TEXAS,
W69-06483 04B

GRINSTEAD, R. R.
RECOVERY OF SALTS FROM SALINE WATER VIA SOLVENT EXTRACTION (FINAL REPORT),
W69-06839 03A

GROVE, M. A.
AGGREGATE KOYCK FUNCTIONS,
W69-06561 06B

GUINDI, BISHAY
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

HACKETT, JAMES E.
WATER RESOURCES AND THE URBAN ENVIRONMENT,
W69-06428 04C

HADAR, JOSEF
OPTIMALITY OF IMPERFECTLY COMPETITIVE RESOURCE ALLOCATION,
W69-06722 06C

HAEFELI, R.
DEFORMATION OF POLYCRYSTALLINE ICE UNDER COMBINED UNIAXIAL AND HYDROSTATIC PRESSURE,
W69-06475 02C

HAGAN, ROBERT
CONFERENCE ON WATER DECISIONS IN THE CRITICAL 1960'S,
W69-06572 06B

HAIMES, YACOV Y.
ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
W69-06813 02F

HALEVY, E.
GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
W69-06811 07B

HAMDI, H.
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

HAMILTON, W.
LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
W69-06799 02J

HAMON, W. RUSSELL
A UNIVERSAL SURFACE PRECIPITATION GAGE,
W69-06804 02B

HANNAFORD, JACK F.
REGIONAL HYDROLOGIC AREA STUDY AS AN ANALYSIS TOOL IN WEATHER MODIFICATION,
W69-06805 02A

HANNAN, E. J.
CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS IN ECONOMICS,
W69-06735 06B

HANSEN, VAUGHN E.
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

HARRILL, J. R.
ESTIMATED WATER USE IN NEVADA, 1950-65,
W69-06446 06D

HARRIS, PETER J.
BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
W69-06840 03A

HARTER, H. LEON
A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
W69-06680 02E

HASKELL, E. E., JR.
THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
W69-06758 02F

HATANAKA, MICHIO
AN HARMONIC ANALYSIS OF NONSTATIONARY MULTIVARIATE ECONOMIC PROCESSES,
W69-06553 06A

HAZAN, RAYMOND
ARTIFICIAL RECHARGE OF A FISSURED SANDSTONE AQUIFER, TANGIERS, MOROCCO (FRENCH),
W69-06487 04B

HEGINBOTTOM, J. A.
SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

HEINDL, L. A.
GROUNDWATER IN FRACTURED VOLCANIC ROCKS IN SOUTHERN ARIZONA,
W69-06831 02F

HELD, E. E.
NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
W69-06766 05A

HENSHAW, RICHARD C., JR.
TESTING SINGLE-EQUATION LEAST SQUARES REGRESSION MODELS FOR AUTOCORRELATED DISTURBANCES,
W69-06565 06A

HERBERT, R.
A DESIGN METHOD FOR DEEP WELL DEWATERING INSTALLATIONS,
W69-06430 02F

HICKMAN, KENNETH
BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
W69-06840 03A

HILEMAN, ANDREW R.
OPEN BREAKER PROTECTION OF EHV SYSTEMS,
W69-06688 08C

HILLEL, D.
A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

HITE, J. C.
ECONOMIC ANALYSIS OF THE DEVELOPMENT POTENTIAL OF THE COMMERCIAL FISHERIES INDUSTRY OF THE COASTAL PLAINS REGION,
W69-06554 06B

HOBBS, P. V.
THE METAMORPHISM OF DRY SNOW AT A UNIFORM TEMPERATURE,
W69-06479 02C

HODGES, ARTHUR L., JR.
GROUND WATER FAVORABILITY MAP OF THE OTTAUQUECHEE-SAXTONS RIVER BASIN, VERMONT,
W69-06463 02F

GROUND WATER FAVORABILITY MAP OF THE WEST-DEERFIELD RIVER BASIN, VERMONT,
W69-06464 02F

GROUND WATER FAVORABILITY MAP OF THE WELLS-OMPOMPANOOSUC RIVER BASIN, VERMONT,
W69-06465 02F

GROUND WATER FAVORABILITY MAP OF THE WHITE RIVER BASIN, VERMONT,
W69-06466 02F

HOFBECK, J. A.
SHEAR TRANSFER IN REINFORCED CONCRETE,
W69-06676 08F

HOLLOWAY, HAROLD D.
MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
W69-06559 03A

HOLTZ, W. G.
SOIL AS AN ENGINEERING MATERIAL,
W69-06699 08D

HOLT, S. J.
A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
W69-06533 05C

HOWE, CHARLES W.
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W69-06502 06D

HOWE, EVERETT D.
THE STATUS OF SEA WATER CONVERSION,
W69-06583 03A

HUSMANN, W.
WATER SUPPLY AND WASTEWATER TREATMENT PROBLEMS OF INDUSTRIAL AND TRADE ENTERPRISES,
W69-06723 05D

HUSSAIN, ASHIG

THE USE OF ERROR COMPONENTS MODELS IN COMBINING CROSS SECTION WITH TIME SERIES DATA,
W69-06552 06A

HUTCHINSON, PETER
ESTIMATION OF RAINFALL IN SPARSELY GAUGED AREAS,
W69-06773 02B

IBRAHIM, I. O.
SHEAR TRANSFER IN REINFORCED CONCRETE,
W69-06676 08F

ISRAELSEN, C. EARL
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

ISSAR, A.
THE GROUNDWATER PROVINCES OF IRAN,
W69-06772 04B

JACCARD, C.
DEFORMATION OF POLYCRYSTALLINE ICE UNDER COMBINED UNIAXIAL AND HYDROSTATIC PRESSURE,
W69-06475 02C

JENNINGS, WILLIAM H.
LEGAL ALTERNATIVES,
W69-06579 06E

JOHNSON, BRUCE
PUBLIC UTILITY PRICING AND OUTPUT UNDER RISK,
W69-06549 06C

JOHNSON, GERALD W.
NUCLEAR EXPLOSIVES,
W69-06581 08H

JONES, S. J.
THE MECHANICAL PROPERTIES OF SINGLE CRYSTALS OF ICE AT LOW TEMPERATURES,
W69-06474 02C

KADANE, J. B.
ESTIMATION OF RETURNS TO SCALE AND THE ELASTICITY OF SUBSTITUTION,
W69-06732 06B

KALLY, ELISHA
PIPELINE PLANNING BY DYNAMIC COMPUTER PROGRAMMING,
W69-06493 06A

KAMAT, D. L.
BENEFICIAL USES OF WATERS OF INTERNATIONAL RIVERS INTERNATIONAL LAW AND PRACTICE,
W69-06458 06E

KAMERSCHEN, DAVID R.
THE INFLUENCE OF OWNERSHIP AND CONTROL ON PROFIT RATES,
W69-06545 06B

KAPKIN, M. M.
TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

KATZ, D. M.
PRINCIPLES OF CHOOSING EXPERIMENTAL PLOTS FOR WATER BALANCE STUDIES IN IRRIGATION REGIONS OF THE ARID ZONE,
W69-06523 02G

KEENE, PHILIP
NON-ENGINEERING ELEMENTS IN FACTORS OF SAFETY IN SOIL AND FOUNDATION ENGINEERING,
W69-06695 08D

KEMPER, WILLIAM D.
CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
W69-06796 03F

KESSLER, E.
RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
W69-06812 02B

KINGSBURY, JOHN M.
APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
W69-06540 07B

KIRILLOV, A. P.
THE MECHANISM OF WATER SEEPAGE THROUGH CONCRETE,
W69-06712 08F

KISNER, RICHARD B., JR.
OPEN BREAKER PROTECTION OF EHV SYSTEMS,
W69-06688 08C

KMENTA, J.
SPECIFICATION AND ESTIMATION OF COBB-DOUGLAS PRODUCTION FUNCTION MODELS,
W69-06560 06A

KOISCH, F. P.
ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

KOMORNIK, AMOS
PREDICTION OF SWELLING PRESSURE OF CLAYS,
W69-06693 08D

KOVALENKO, V. A.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE VIBRATIONS OF THE ROTOR OF A FULL-SCALE-MODEL HYDROELECTRIC INSTALLATION,
W69-06698 08C

KRISHNAIAH, P. R.
SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS,
W69-06569 06A

KRUTCHKOFF, RICHARD G.
STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
W69-06500 05B

KULIK, M. S.
DROUGHT AND SOIL MOISTURE,
W69-06529 02G

KUROIWA, DAISUKE
LIQUID PERMEABILITY OF SNOW,
W69-06478 02C

LABADIE, JOHN W.
QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
W69-06822 02A

LADD, GEORGE W.
LINEAR PROBABILITY FUNCTIONS AND DISCRIMINANT FUNCTIONS,
W69-06563 06A

LAMBERT, JERRY R.
A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

LANDSBERG, HANS H.
DESALTED SEAWATER FOR AGRICULTURE IS IT ECONOMIC,
W69-06765 03F

LANG, HEBBERT
RELATIONS BETWEEN GLACIER RUNOFF AND METEOROLOGICAL FACTORS OBSERVED ON AND OUTSIDE THE GLACIER,
W69-06481 02C

LAWTON, VINCENT
CONFERENCE ON WATER DECISIONS IN THE CRITICAL 1960'S,
W69-06572 06B

LEE, G. FRED
THE AGING OF LAKES,
W69-06535 02H

LEE, KENNETH L.
HORIZONTAL MOVEMENTS RELATED TO SUBSIDENCE,
W69-06692 08D

LEE, RICHARD
THE HYDROLOGIC IMPORTANCE OF TRANSPIRATION CONTROL BY STOMATA,
W69-06520 02D

LEGRAND, HARRY E.
ROLE OF GROUND WATER CONTAMINATION IN WATER MANAGMENT,
W69-06762 05G

LENNOX, D. H.
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

LEWANDOWSKI, EDWARD R.
FOUNDATION PROBLEMS OF RUEDI DAM AND RESERVOIR,
W69-06673 08E

LIEBMAN, JON C.
A HEURISTIC AID FOR THE DESIGN OF SEWER NETWORKS,
W69-06498 05E

LIGON, JAMES T.
EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
W69-06514 02G

LINAWEAVER, F. P., JR.
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W69-06502 06D

LISACK, J. P.
MANPOWER REQUIREMENTS FOR POLLUTION CONTROL AND WATER RESOURCES IN INDIANA AND A RELATED POLLUTION CONTROL TECHNOLOGY CURRICULUM,
W69-06507 05G

LLOYD, L. W.
A SWING RELAY FOR THE EAST-WEST INTERTIE,
W69-06687 08C

LOKEN, TOR
STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

LOW, S. S.
SHUNT CAPACITOR ENERGIZATION WITH VACUUM INTERRUPTERS--A POSSIBLE SOURCE OF OVERVOLTAGE,
W69-06689 08C

LUTHIN, JAMES N.
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

MADDALA, G. S.
ESTIMATION OF RETURNS TO SCALE AND THE ELASTICITY OF SUBSTITUTION,
W69-06732 06B

MAKEDONSKII, G. M.
THERMAL STRESS CONDITION OF EXPERIMENTAL LONG BLOCKS DURING CONSTRUCTION PERIOD OF THE BRATSK HYDROELECTRIC STATION DAM,
W69-06711 08F

MARGLIN, STEPHEN A.
THE OPPORTUNITY COSTS OF PUBLIC INVESTMENT,
W69-06739 06B

MARTENS, LAWRENCE A.
FLOOD INUNDATION AND EFFECTS OF URBANIZATION IN METROPOLITAN CHARLOTTE, NORTH CAROLINA,
W69-06445 04C

MARTINEC, J.
GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
W69-06811 07B

MAR, BRIAN W.
SLUDGE DISPOSAL ALTERNATIVES -- SOCIO-ECONOMIC CONSIDERATIONS,
W69-06492 05E

MASLOC, BORIS
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

MATHRANI, K. P.
CONSTRUCTION AND MANAGEMENT OF RIVER VALLEY PROJECTS IN INDIA,
W69-06457 04A

MATTOCK, ALAN H.
SHEAR TRANSFER IN REINFORCED CONCRETE,
W69-06676 08F

MAZOR, EMANUEL
GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

MAZOR, E.
GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

MAZUR, B. M.
TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

MCCAIN, J. F.
GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
W69-06816 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
W69-06819 02F

MCCORMICK, JAMES F.
THE COMPETITION FOR WATER QUALITY RECREATION,
W69-06573 06D

MCDONALD, HARRIS R.
ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
W69-06509 02F

MCHENRY, J. ROGER,
USE OF TRACER TECHNIQUE IN SOIL EROSION RESEARCH,
W69-06704 04D

MCITHENNEY, W. F.
A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS PART 1,
W69-06556 03C

MCPHERSON, M. B.
AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
W69-06770 04C

MCWILLIAMS, R. D.
GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CHENSHAW COUNTY, ALABAMA,
W69-06817 02F

MEISLER, HAROLD
SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

MERO, FELIX
GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

MERRITT, GARY L.
EFFECTS OF MINE DRAINAGE ON GROUND WATER,
W69-06425 05C

MIDGLEY, D. C.
OPERATION OF MULTI-UNIT MULTI-PURPOSE WATER DEVELOPMENT SYSTEMS,
W69-06462 06D

MILLER, ERVIN E.
COMPUTER-AIRPLANE COMBO SAVES QUARTER MILLION DOLLARS ON SURVEYS AND ADMINISTRATION OF CONSTRUCTION CONTRACTS,
W69-06697 07B

MINSHALL, NEAL E.
PRECIPITATION AND BASE FLOW VARIABILITY,
W69-06443 02B

MITCHELL, J. MURRAY, JR.
SOME REMARKS ON THE PREDICTABILITY OF DROUGHT AND RELATED CLIMATIC ANOMALIES,
W69-06439 02B

MITWALLY, SALAH ELDIN
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

MORESHET, S.
THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

MORGAN, ELMO B.
ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

MORTIMER, C. H.
THE WORK OF THE FRESHWATER BIOLOGICAL ASSOCIATION OF GREAT BRITAIN IN REGARD TO WATER SUPPLIES. (A) THE NITROGEN BALANCE OF LARGE QUANTITIES OF WATER,
W69-06538 02K

MOSKVIN, V. M.
TEMPERATURE VOLUMETRIC CHANGES OF CONCRETE AT SUBZERO TEMPERATURES,
W69-06672 08F

MOSSLANG, HANS
USE OF ASPHALTIC CONCRETE IN COASTAL AND CANAL CONSTRUCTION,
W69-06682 08F

MOUM, JOHAN
STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

MOUNT, J. RUSSELL
A SIMPLIFIED TECHNIQUE FOR WELL-FIELD DESIGN,
W69-06421 02F

MUEHLBERG, P. E.
A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS PART 1,
W69-06556 03C

MUELLER, C. R.
INTERMOLECULAR FORCES AND THE LIQUID STATE,
W69-06838 01A

MUHLECK, HEINZ
THE GENERAL WATER SCHEME - AN ESSENTIAL BASIS FOR THE MOST RATIONAL USE OF WATER RESOURCES,
W69-06724 06B

MULLIGAN, HUGH F.
APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
W69-06540 07B

MUNDLAK, YAIR
LONG-RUN COEFFICIENTS AND DISTRIBUTED LAG ANALYSIS A REFORMULATION,
W69-06557 06A

MURTHY, V. K.
SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS,
W69-06569 06A

MUSICK, J. T.
EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
W69-06511 03F

MUTH, RICHARD F.
HOUSEHOLD PRODUCTION AND CONSUMER DEMAND FUNCTIONS,
W69-06566 06D

MYERS, V. I.
DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
W69-06512 02G

NAMIAS, JEROME
FURTHER STUDIES OF DROUGHT OVER NORTHEASTERN UNITED STATES,
W69-06438 02B

NARAYAN, C. V.
DISTANCE PROTECTION OF HIGH-VOLTAGE LINES CONTAINING SERIES

CAPACITORS,
W69-06710 08C

NEILL, D. E.
MEASUREMENT OF ROTATING MACHINERY VIBRATION AND FACTORS AFFECTING INSTRUMENT ACCURACY,
W69-06702 07B

NEWTON, J. G.
WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
W69-06816 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
W69-06817 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
W69-06818 02F

NITTA, ROY Y.
ELECTRICAL FEATURES OF THE GRAND COULEE THIRD POWER PLANT,
W69-06684 08C

NORTHROP, WILLIA L.
KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

ORCUTT, GUY H.
FIRST ORDER AUTO REGRESSION INFERENCE, ESTIMATION, AND PREDICTION,
W69-06550 06A

ORCUTT, R. G.
RECLAIMED WASTE WATER IN LAS VEGAS VALLEY,
W69-06832 05D

ORLOB, GERALD T.
WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
W69-06499 05G

ORTOLANO, LEONARD
ECONOMIC FRAMEWORK FOR SALINITY CONTROL PROJECTS,
W69-06490 05D

OSSMAN, W. R.
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

OWENS, WILLARD G.
GEOLOGY, DESIGN, AND CONSTRUCTION OF DEEP WELLS IN SEDIMENTARY FOUNDATIONS,
W69-06759 02F

OWENS, W. H.
LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
W69-06799 02J

PALMER, WAYNE C.
THE ABNORMALLY DRY WEATHER OF 1961-1966 IN THE NORTHEASTERN UNITED STATES,
W69-06437 02B

PARKER, MARSHALL E.
INNOVATIONS AND THE FUTURE OF CATHODIC PROTECTION,
W69-06677 08A

PARKER, RICHARD A.
SIMULATION OF AN AQUATIC ECOSYSTEM,
W69-06536 02H

PARRY, J. T.
SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

PATTERSON, W. S. B.
A TEMPERATURE PROFILE THROUGH THE MEIGHEN ICE CAP, ARCTIC CANADA,
W69-06482 02C

PAULSON, RICHARD W.
PRELIMINARY REMOTE SENSING OF THE DELAWARE ESTUARY,
W69-06793 02L

PAVANELLO, R.
WATER POLLUTION CONTROL,
W69-06731 05G

PAYNE, B. R.
GUIDEBOOK ON NUCLEAR TECHNIQUES IN HYDROLOGY,
W69-06811 07B

PETERSON, GEORGE L.
CIVIL ENGINEERING AND URBAN SYSTEMS,
W69-06491 06A

PHADKE, A. G.
CALCULATION OF BALANCED AND UNBALANCED FAULT CURRENTS IN AC-DC POWER SYSTEMS,
W69-06690 08C

PHILIP, J. R.
EXTENDED TECHNIQUES OF CALCULATION OF SOIL-WATER MOVEMENT, WITH SOME PHYSICAL CONSEQUENCES,
W69-06714 02G

PHILLIPS, CLIFFORD J.
KANSAS RIVER BASIN FLOOD CONTROL,
W69-06729 06B

PHILLIPS, H. BOYD
ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
W69-06509 02F

PICKERING, R. J.
DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
W69-06785 05B

PIGFORD, THOMAS
NUCLEAR REACTORS,
W69-06582 03A

PILLSBURY, ARTHUR F.
PROCEEDINGS OF TILE DRAINAGE RESEARCH CONFERENCE,
W69-06795 04A

POTTER, PAUL E.
RANDOM PROCESSES AND LITHOLOGIC TRANSITIONS,
W69-06807 02J

PREHN, W. LAWRENCE
MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
W69-06559 03A

PYPER, G. E.
EXTENSIONS OF STREAMFLOW RECORDS IN UTAH,
W69-06447 02E

QUANDT, RICHARD E.
MAXIMIZATION BY QUADRATIC HILL-CLIMBING,
W69-06564 06A

RADWANSKI, S. A.
FIELD OBSERVATIONS OF SOME PHYSICAL PROPERTIES IN ALLUVIAL SOILS OF ARID AND SEMI-ARID REGIONS,
W69-06515 02G

RAO, K. L.
PLANNING AND DEVELOPMENT OF WATER RESOURCES IN INDIA,
W69-06728 06B

RAWITZ, E.
A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

REED, P. C.
WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
W69-06451 02E

REES, A. I.
LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
W69-06799 02J

REGER, RICHARD D.
RECENT HISTORY OF GULKANA AND COLLEGE GLACIERS, CENTRAL ALASKA RANGE, ALASKA,
W69-06808 02C

REID, J. K.
EXTENSIONS OF STREAMFLOW RECORDS IN UTAH,
W69-06447 02E

RESTALL, ROBERT
SAFETY CONTROL OF PRIVATE DAMS,
W69-06433 04A

REVELLE, CHARLES
THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
W69-06547 05F

RHODEHAMEL, EDWARD C.
SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

RICE, T. R.
PROGRESS REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY, BEAUFORT, N. C., FISCAL YEAR 1968,
W69-06769 09C

RICHARDSON, C. W.
GRADED FURROWS FOR WATER EROSION CONTROL,
W69-06746 02J

RICHARDS, RICHARD
THE LEGISLATIVE POINT OF VIEW,
W69-06580 06E

RICHARDS, WILLIAM E.
CONSERVATION'S CHALLENGE TO STATE GOVERNMENTS,
W69-06586 06E

RIJKS, D. A.
WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
W69-06756 03F

ROBECK, GORDON G.

MICROBIAL PROBLEMS IN GROUNDWATER,
W69-06426 05C

ROBERTSON, GEORGE W.
THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

ROBINSON, FRANK
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

RODE, A. A.
THEORY OF SOIL MOISTURE - VOL 1, MOISTURE PROPERTIES OF SOILS AND MOVEMENT OF SOIL MOISTURE,
W69-06489 02G

ROLL, J. ROBERT
EFFECT OF SUBSIDENCE ON WELL FIELDS,
W69-06763 04B

ROSENTHAL, E.
GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

RU MAA, JER
BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
W69-06840 03A

RUNKLES, J. R.
WATER FOR TEXAS,
W69-06790 06B

RUSH, EUGENE F.
GEOLOGY AND GROUND-WATER RESOURCES OF BURLINGTON COUNTY, NEW JERSEY,
W69-06449 02F

RUSH, F. EUGENE
WATER-RESOURCES APPRAISAL OF THE LOWER MOAPA-LAKE MEAD AREA, CLARK COUNTY, NEVADA,
W69-06435 02F

RUTLAND, R. W. R.
GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
W69-06681 07B

SAGER, PAUL EDWIN
SPECIES DIVERSITY AND COMMUNITY STRUCTURE IN LACUSTRINE PHYTOPLANKTON,
W69-06542 02H

SANDERSON, WALLACE W.
ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

SARBACH, E.
SOME ASPECTS OF INSULATION CO-ORDINATION IN HVDC SYSTEMS,
W69-06707 08C

SARVARY, I.
TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
W69-06774 07B

SCHAEFER, ROBERT W.
ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

SCHLEIF, F. R.
A SWING RELAY FOR THE EAST-WEST INTERTIE,
W69-06687 08C

SCHMIDT, K.
SUL-BISUL(T) ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W69-06836 03A

SCHNEIDER, A. D.
EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
W69-06511 03F

SCHUMM, S. A.
A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
W69-06513 02J

SCHWARK, D.
SUL-BISUL(T) ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W69-06836 03A

SCOTT, J. C.
WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
W69-06451 02E

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
W69-06815 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
W69-06817 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
W69-06818 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
W69-06819 02F

SELLEY, RICHARD C.
A CLASSIFICATION OF PALEOCURRENT MODELS,
W69-06810 02J

SENGER, D.
SUL-BISUL(T) ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W69-06836 03A

SEWELL, WADE R.
LEAST SQUARES, CONDITIONAL PREDICTIONS, AND ESTIMATOR PROPERTIES,
W69-06551 06A

SHAMBURGER, VICTOR M., JR.
GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
W69-06815 02F

SHANNON, WALTER
THE COMPETITION FOR WATER QUANTITY RECREATION,
W69-06578 06D

SHEN, C. K.
HORIZONTAL MOVEMENTS RELATED TO SUBSIDENCE,
W69-06692 08D

SHIRLEY, WILLIAM O.
USE OF DIGITAL COMPUTERS IN DISTRIBUTION SYSTEM ANALYSES,
W69-06503 07C

SIMONETT, DAVID S.
POTENTIAL OF RADAR REMOTE SENSORS AS TOOLS IN RECONNAISSANCE GEOMORPHIC, VEGETATION AND SOIL MAPPING,
W69-06718 07B

SLISSKII, S. M.
COMPUTATION OF PRESSURES AND VELOCITIES IN THE CURVILINEAR ZONE OF PRESSURE SPILLWAYS, FOR PREDICTING CAVITATION,
W69-06713 08B

SMITH, H. G.
A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS PART 1,
W69-06556 03C

SMITH, V. KERRY
THE CES PRODUCTION FUNCTION A DERIVATION,
W69-06720 06B

SNIDER, S. W.
RECOVERY OF SALTS FROM SALINE WATER VIA SOLVENT EXTRACTION (FINAL REPORT),
W69-06839 03A

SOKOLOSKI, ADAM A.
SOME POSSIBLE ROLES FOR INSTITUTIONS AND ECONOMICS IN WATER RESOURCE MANAGEMENT,
W69-06725 06B

SOPP, OLVA IHLEN
STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

SPAR, JEROME
DROUGHT IN THE NORTHEASTERN UNITED STATES,
W69-06436 02B

SPENCER, ERIC
CIRCULAR AND LOGARITHMIC SPIRAL SLIP SURFACES,
W69-06694 08D

STANHILL, G.
THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

STEINER, PETER O.
THE ROLE OF ALTERNATIVE COST IN PROJECT DESIGN AND SELECTION,
W69-06738 06B

CHOOSING AMONG ALTERNATIVE PUBLIC INVESTMENTS IN THE WATER RESOURCE FIELD,
W69-06740 06B

STEIN, MURRAY
POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
W69-06802 05B

STENSEL, DAVID
THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
W69-06547 05F

STEPHENS, JERRY C.
GEOLOGY AND HYDROLOGY OF CLAY COUNTY SOUTH DAKOTA-PART 1, GEOLOGY, AND PART 2, WATER RESOURCES,
W69-06486 02F

STEPP, J. M.
ECONOMIC ANALYSIS OF THE DEVELOPMENT POTENTIAL OF THE COMMERCIAL FISHERIES INDUSTRY OF THE COASTAL PLAINS REGION,
W69-06554 06B

STONE, L. R.
DYNAMIC SIMULATION MODEL OF THE TRANSPIRATION PROCESS,
W69-06504 02D

SUBRAHMANYAM, V. P.
SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
W69-06524 02G

SUBRAMANIAM, A. R.
SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
W69-06524 02G

SWANSON, ROBERT H.
A SYSTEM FOR MAKING REMOTE AND UNDISTURBED MEASUREMENTS OF SNOW SETTLEMENT AND TEMPERATURES,
W69-06803 02C

SWIFT, DONALD J.
COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
W69-06798 02L

SYDKO, A. A.
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W69-06716 03F

SYKES, JAMES E.
REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
W69-06767 09C

SZABOLCS, I.
SALT BALANCE AND SALT TRANSPORT PROCESSES IN IRRIGATED SOILS,
W69-06717 03F

TAYLOR, D. C.
AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
W69-06770 04C

THAYER, RICHARD P.
STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
W69-06500 05B

THOMAS, C. A.
INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO,
W69-06427 02E

THOMAS, HAROLD E.
WATER LAWS AND CONCEPTS,
W69-06683 08E

THORDARSON, WILLIAM
RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
W69-06820 02F

THORLEY, A. R. D.
PRESSURE TRANSIENTS IN HYDRAULIC PIPELINES,
W69-06700 08A

TROTTER, HALE F.
MAXIMIZATION BY QUADRATIC HILL-CLIMBING,
W69-06564 06A

TUCKER, L. S.
AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
W69-06770 04C

TURNER, J. D.
WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
W69-06819 02F

TURNER, WILLIAM R.
A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
W69-06764 07C

TZUR, Y.
THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

ULLMANN, WILLIAM W.
ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

UNGEMACH, P.
THE USE OF ELECTRIC ANALOG MODELS IN HYDRODYNAMICAL STUDY OF THE ALSACE AQUIFERS (FRENCH),
W69-06806 02F

VAHIDI, M.
THE POSSIBILITY OF USING A MOVABLE DAM THE 'FABRIDAM' AND ITS APPLICATION IN ARID REGIONS,
W69-06455 04A

VAN DE PANNE, C.
A PARAMETRIC SIMPLICAL FORMULATION OF HOUTHAKKER'S CAPACITY METHOD,
W69-06568 06A

VAN HYLCKAMA, T. E. A.
PHOTOSYNTHESIS AND WATER USE BY SALTCEDAR,
W69-06771 03B

VAN SCHILFGAARDE, JAN
A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

VANDEN BERG, A.
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

VILIMONOVIC, J.
A CONTRIBUTION TO THE STUDY OF GROUNDWATER INTAKE RECHARGE IN KARST,
W69-06484 02F

WAGGONER, EUGENE B.
GEOLOGY, DESIGN, AND CONSTRUCTION OF DEEP WELLS IN SEDIMENTARY FOUNDATIONS,
W69-06759 02F

WAGNER, CHARLES L.
OPEN BREAKER PROTECTION OF EHV SYSTEMS,
W69-06688 08C

WAKAHAMA, GOROW
THE METAMORPHISM OF WET SNOW,
W69-06477 02C

WALLACE, T. D.
THE USE OF ERROR COMPONENTS MODELS IN COMBINING CROSS SECTION WITH TIME SERIES DATA,
W69-06552 06A

WAUGH, FREDERICK V.
CONSUMER ASPECTS OF PRICE INSTABILITY,
W69-06570 06C

WEAVER, CHARLES E.
POTASSIUM, ILLITE AND THE OCEAN,
W69-06506 02K

WEAVER, THOMAS R.
MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
W69-06559 03A

WEINMANN, T.
TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH VOLTAGE INSULATORS.
W69-06708 08C

WELLER, G.
THE ANNUAL HEAT ENERGY TRANSFER ABOVE AND INSIDE ANTARCTICA BLUE ICE,
W69-06480 02C

WEYLAND, HERMAN
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W69-06837 03A

WHINSTON, ANDREW
A PARAMETRIC SIMPLICAL FORMULATION OF HOUTHAKKER'S CAPACITY METHOD,
W69-06568 06A

WHITE, O. D.
RELATION OF A HYDROLOGIC INDEX TO MEAN ANNUAL FLOW,
W69-06441 02B

WHITE, WILLIAM B.
CONCEPTUAL MODELS FOR CARBONATE AQUIFERS,
W69-06423 02F

WIENER, A.
IRRIGATION WATER SYSTEM--ISRAEL'S NATIONAL WATER GRID,
W69-06459 03F

WILDE, D. J.
OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
W69-06495 03A

WILK, K. E.
RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
W69-06812 02B

WILLIAMS, B. A.
OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
W69-06495 03A

WILLIAMS, MERLIN C.
REGIONAL HYDROLOGIC AREA STUDY AS AN ANALYSIS TOOL IN WEATHER MODIFICATION,
W69-06805 02A

WILLIAMS, M. A. J.
PREDICTION OF RAINSPLASH EROSION IN THE SEASONALLY WET TROPICS,
W69-06768 02J

WILLIS, WALTER J.
WATER TRANSPORTATION-IMPACT ON ECONOMIC DEVELOPMENT,
W69-06730 06B

WILM, HAROLD G.
INTERGOVERNMENTAL PLANNING OF WATER RESOURCES,
W69-06429 06B

WINOGRAD, I. J.
RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
W69-06820 02F

WINOKUR, HERBERT S., JR.
FIRST ORDER AUTO REGRESSION INFERENCE, ESTIMATION, AND PREDICTION,
W69-06550 06A

WOERNER, JACK
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

WOODLEY, N. H.
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

WOODS, PHILIP C.
WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
W69-06499 05G

WOO, K. B.
DYNAMIC SIMULATION MODEL OF THE TRANSPIRATION PROCESS,
W69-06504 02D

WORLD, R. W.
A SWING RELAY FOR THE EAST-WEST INTERTIE,
W69-06687 08C

WORRALL, RICHARD D.
CIVIL ENGINEERING AND URBAN SYSTEMS,
W69-06491 06A

WORTS, G. F., JR.
ESTIMATED WATER USE IN NEVADA, 1950-65,
W69-06446 06D

YEVJEVICH, VUJICA
EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
W69-06789 02A

YOUNG, G. K.
RESERVOIR MANAGEMENT THE TRADEOFF BETWEEN LOW-FLOW REGULATION AND FLOOD CONTROL,
W69-06496 04A

YOUNG, R. A.
RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
W69-06820 02F

ZELLNER, A.
SPECIFICATION AND ESTIMATION OF COBB-DOUGLAS PRODUCTION FUNCTION MODELS,
W69-06560 06A

ZIMA, K.
SOME DETAILS ON THE CIRCULATION OF GROUNDWATER IN NON-KARSTIFIED FISSURED FORMATIONS IN CZECHOSLOVAKIA (FRENCH),
W69-06485 02F

ZLATEN, ALEXANDER
FOUNDATION PROBLEMS OF RUEDI DAM AND RESERVOIR,
W69-06673 08E

ORGANIZATIONAL INDEX

AEROJET-GENERAL CORP., EL MONTE, CALIF.
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W69-06837 03A

AEROJET-GENERAL CORP., EL MONTE, CALIF. ENVIRONMENTAL SYSTEMS DIV. AND ENGINEERING-SCIENCE, INC., ARCADIA, CALIF.
SYSTEMS APPROACH FOR INTEGRATING GROUND WATER AND SURFACE WATER USE.
W69-06834 06A

AEROSPACE RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO AND DOUGLAS AIRCRAFT CO., INC., SANTA MONICA, CALIF.
SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS,
W69-06569 06A

AEROSPACE RESEARCH LABS., WRIGHT-PATTERSON AFB, OHIO.
A NEW TABLE OF PERCENTAGE POINTS OF THE PEARSON TYPE III DISTRIBUTION,
W69-06680 02E

AGRICULTURAL RESEARCH SERVICE, BOISE, IDAHO. SOIL AND WATER CONSERVATION RESEARCH DIV.
A UNIVERSAL SURFACE PRECIPITATION GAGE,
W69-06804 02B

AGRICULTURAL RESEARCH SERVICE, MADISON, WIS. SOIL AND WATER CONSERVATION RESEARCH DIV.
PRECIPITATION AND BASE FLOW VARIABILITY,
W69-06443 02B

AGRICULTURAL RESEARCH SERVICE, OXFORD, MISS.
USE OF TRACER TECHNIQUE IN SOIL EROSION RESEARCH,
W69-06704 04D

AGRICULTURAL RESEARCH SERVICE, RIVERSIDE, CALIF. SALINITY LAB.
SOIL-WATER DIFFUSIVITY BY THE ONE-STEP METHOD,
W69-06528 02G

AGRICULTURAL RESEARCH SERVICE, WASHINGTON, D. C. SOIL AND WATER RESEARCH DIV. AND SOUTH DAKOTA STATE UNIV., BROOKINGS. REMOTE SENSING INST.
DRAINING AREA UNDERLAIN BY HIGHLY PERMEABLE SHALLOW SAND AQUIFER,
W69-06512 02G

AIN SHAMS UNIV., CAIRO (EGYPT). DEPT. OF SOILS.
A COMPARATIVE STUDY OF HYDRAULIC CONDUCTIVITY IN THE ALLUVIAL SOILS OF EGYPT,
W69-06517 02F

AKADEMIYA NAUK SSSR, MOSCOW. POCHVENNYI INSTITUT.
THEORY OF SOIL MOISTURE - VOL 1, MOISTURE PROPERTIES OF SOILS AND MOVEMENT OF SOIL MOISTURE,
W69-06489 02G

ALABAMA GEOLOGICAL SURVEY, UNIVERSITY AND GEOLOGICAL SURVEY, WASHINGTON, D. C.
WATER AVAILABILITY, CONECUH COUNTY, ALABAMA,
W69-06451 02E

WATER AVAILABILITY, COFFEE COUNTY, ALABAMA,
W69-06452 02F

ALABAMA GEOLOGICAL SURVEY, UNIVERSITY AND GEOLOGICAL SURVEY, UNIVERSITY, ALA.
GEOLOGIC MAP AND WATER AVAILABILITY MAP OF PIKE COUNTY, ALABAMA,
W69-06815 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF HENRY COUNTY, ALABAMA,
W69-06816 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF CRENSHAW COUNTY, ALABAMA,
W69-06817 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF DALE COUNTY, ALABAMA,
W69-06818 02F

GEOLOGIC MAP AND WATER AVAILABILITY MAP OF COVINGTON COUNTY, ALABAMA,
W69-06819 02F

ALL-UNION SCIENTIFIC RESEARCH INST. OF HYDROGEOLOGY AND ENGINEERING GEOLOGY, MOSCOW (USSR).
PRINCIPLES OF CHOOSING EXPERIMENTAL PLOTS FOR WATER BALANCE STUDIES IN IRRIGATION REGIONS OF THE ARID ZONE,
W69-06523 02G

AMERICAN SOCIETY OF CIVIL ENGINEERS, CAMBRIDGE, MASS. URBAN HYDROLOGY RESEARCH COUNCIL.
AN ANALYSIS OF NATIONAL BASIC INFORMATION NEEDS IN URBAN HYDROLOGY,
W69-06770 04C

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF METEOROLOGY AND OCEANOGRAPHY.
SOME CHARACTERISTICS AND FREQUENCIES OF OCCURRENCE OF DROUGHTS IN THE DRY CLIMATIC ZONES OF INDIA,
W69-06524 02G

ARIZONA STATE UNIV., TEMPE. DEPT. OF GEOLOGY.
RECENT HISTORY OF GULKANA AND COLLEGE GLACIERS, CENTRAL ALASKA RANGE, ALASKA,
W69-06808 02C

ASSOCIATED SPORTSMEN OF CALIFORNIA, SAN FRANCISCO.
THE COMPETITION FOR WATER QUALITY RECREATION,
W69-06573 06D

AUSTRALIAN NATIONAL UNIV., CANBERRA.
CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS IN ECONOMICS,
W69-06735 06B

AUSTRALIAN NATIONAL UNIV., CANBERRA. RESEARCH SCHOOL OF PACIFIC STUDIES.
PREDICTION OF RAINSPLASH EROSION IN THE SEASONALLY WET TROPICS,
W69-06768 02J

BATTELLE MEMORIAL INST., COLUMBUS, OHIO.
THE DESIRABILITY AND APPLICABILITY OF SIMULATING ECOSYSTEMS,
W69-06537 06A

BECHTEL CORP., SAN FRANCISCO, CALIF.
DESIGN AND CONSTRUCTION OF DAMS FOR RETENTION OF SOLID WASTES,
W69-06675 05G

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
A DESIGN METHOD FOR DEEP WELL DEWATERING INSTALLATIONS,
W69-06430 02F

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF GEOLOGY.
LABORATORY EXPERIMENTS ON THE PRODUCTION OF GRAIN ORIENTATION IN SHEARING SAND,
W69-06799 02J

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF PHYSICS.
THE MECHANICAL PROPERTIES OF SINGLE CRYSTALS OF ICE AT LOW TEMPERATURES,
W69-06474 02C

THE IMPORTANCE OF THE HYDROGEN ATOM ARRANGEMENT IN DETERMINING HOW ICE CAN DEFORM PLASTICALLY,
W69-06476 02C

BLACK AND VEATCH, KANSAS CITY, MO.
ECONOMIC EFFECTS OF MINERAL CONTENT IN MUNICIPAL WATER SUPPLIES.
W69-06555 03A

BLACKLANDS EXPERIMENT WATERSHED, HIESEL, TEX. AND TEXAS A AND M UNIV., COLLEGE STATION. BIG SPRING FIELD STATION.
GRADED FURROWS FOR WATER EROSION CONTROL,
W69-06746 02J

BRIGHAM YOUNG UNIV., PROVO, UTAH AND DOW CHEMICAL CO., MIDLAND, MICH.
A FEASIBILITY STUDY ON THE UTILIZATION OF WASTE BRINE FROM SALINATION PLANTS PART 1,
W69-06556 03C

BRITISH COLUMBIA UNIV., VANCOUVER.
INTERREGIONAL PRODUCTION AND WATER RESOURCE DEPENDENCIES AMONG THE WESTERN STATES,
W69-06721 06B

ON THE RELATIVE SMALL-SAMPLE PROPERTIES OF SEVERAL STRUCTURAL-EQUATION ESTIMATORS,
W69-06734 06B

BROWN BOVERI AND CO. LTD., BADEN (SWITZERLAND).
TOWARDS STANDARDIZING THE ARTIFICIAL-POLLUTION TEST FOR HIGH VOLTAGE INSULATORS.
W69-06708 08C

BROWN, BOVERI AND CO. LTD., BADEN (SWITZERLAND).
SOME ASPECTS OF INSULATION CO-ORDINATION IN HVDC SYSTEMS,
W69-06707 08C

BROWN BOVERI DISTANCE PROTECTION SYSTEMS EMPLOYING CARRIER TRANSPER,
W69-06709 08C

DISTANCE PROTECTION OF HIGH-VOLTAGE LINES CONTAINING SERIES CAPACITORS,
W69-06710 08C

BUREAU OF COMMERCIAL FISHERIES, BEAUFORT, N. C. RADIOBIOLOGICAL LAB.
PROGRESS REPORT OF THE BUREAU OF COMMERCIAL FISHERIES RADIOBIOLOGICAL LABORATORY, BEAUFORT, N. C., FISCAL YEAR 1968,
W69-06769 09C

BUREAU OF RECLAMATION, BOISE, IDAHO.
COMPUTER-AIRPLANE COMBO SAVES QUARTER MILLION DOLLARS ON SURVEYS AND ADMINISTRATION OF CONSTRUCTION CONTRACTS,
W69-06697 07B

BUREAU OF RECLAMATION, DENVER, COLO.
FOUNDATION PROBLEMS OF RUEDI DAM AND RESERVOIR,
W69-06673 08E

HIGH EARTHFILL DAM FOUNDATION GROUTING DESIGN AND CONSTRUCTION PROCEDURES,
W69-06674 08D

ELECTRICAL FEATURES OF THE GRAND COULEE THIRD POWER PLANT,
W69-06684 08C

A SWING RELAY FOR THE EAST-WEST INTERTIE,
W69-06687 08C

SOIL AS AN ENGINEERING MATERIAL,
W69-06699 08D

BUREAU OF RECLAMATION, DENVER, COLO. EXPERIMENTAL DESIGN ANALYSIS SECTION AND BUREAU OF RECLAMATION, DENVER, COLO. WATER UTILIZATION BRANCH.
ANALOG OF GROUND WATER IN EAST-CENTRAL NEW MEXICO,
W69-06509 02F

BUREAU OF RECLAMATION, SACRAMENTO, CALIF.
THE COMPETITION FOR WATER QUANTITY,
W69-06574 06D

CAIRO UNIV. (EGYPT). DEPT. OF BOTANY.
TRANSPIRATION OF DESERT PLANTS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
W69-06526 02D

CALIFORNIA DEPT. OF FISH AND GAME, SACRAMENTO.
THE COMPETITION FOR WATER QUANTITY RECREATION,
W69-06578 06D

CALIFORNIA UNIVERSITY, DAVIS. WATER RESOURCES CENTER.
CONFERENCE ON WATER DECISIONS IN THE CRITICAL 1960'S,
W69-06572 06B

CALIFORNIA UNIV., BERKELEY, CALIF.
COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
W69-06733 06B

CALIFORNIA UNIV., BERKELEY.
WATER QUALITY MANAGEMENT ENGINEERING-ECONOMIC FACTORS IN MUNICIPAL WASTE DISPOSAL,
W69-06505 05D

NUCLEAR REACTORS,
W69-06582 03A

THE STATUS OF SEA WATER CONVERSION,
W69-06583 03A

CALIFORNIA UNIV., EL CENTRO. EL CENTRO FIELD STATION.
DISPLACEMENT FRONT UNDER PONDED LEACHING,
W69-06510 02G

CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
NUCLEAR EXPLOSIVES,
W69-06581 08H

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF ENGINEERING AND NEVADA UNIV., RENO. DEPT. OF WATER RESOURCES.
QUASILINEARIZATION APPROACH TO THE IDENTIFICATION OF HYDROLOGIC SYSTEMS,
W69-06822 02A

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF ENGINEERING.
ON MULTILEVEL OPTIMIZATION IN GROUND WATER SYSTEMS,
W69-06813 02F

CALIFORNIA, UNIV., LOS ANGELES AND CALIFORNIA UNIV., DAVIS.
HORIZONTAL MOVEMENTS RELATED TO SUBSIDENCE,
W69-06692 08D

CARRIER CORP., SYRACUSE, N. Y.
MEASUREMENT OF ROTATING MACHINERY VIBRATION AND FACTORS AFFECTING INSTRUMENT ACCURACY,
W69-06702 07B

CASE WESTERN RESERVE UNIV., CLEVELAND, OHIO.
OPTIMALITY OF IMPERFECTLY COMPETITIVE RESOURCE ALLOCATION,
W69-06722 06C

CENTRAL WATER AND POWER COMMISSION (INDIA).
A CENTURY OF DESIGN AND CONSTRUCTION OF IRRIGATION WORKS IN INDIA,
W69-06461 04A

CHICAGO UNIV., ILL. AND INSTITUTE FOR DEFENSE ANALYSES, ARLINGTON, VA.
HOUSEHOLD PRODUCTION AND CONSUMER DEMAND FUNCTIONS,
W69-06566 06D

CHICAGO UNIV., ILL. MICHIGAN STATE UNIV., EAST LANSING AND LOUVAIN UNIV. (BELGIUM).
SPECIFICATION AND ESTIMATION OF COBB-DOUGLAS PRODUCTION FUNCTION MODELS,
W69-06560 06A

CITY UNIV., LONDON (ENGLAND).
PRESSURE TRANSIENTS IN HYDRAULIC PIPELINES,
W69-06700 08A

CLEMSON UNIV., S. C.
EVALUATION OF THE GAMMA TRANSMISSION METHOD FOR DETERMINING SOIL WATER BALANCE AND EVAPOTRANSPIRATION,
W69-06514 02G

ECONOMIC ANALYSIS OF THE DEVELOPMENT POTENTIAL OF THE COMMERCIAL FISHERIES INDUSTRY OF THE COASTAL PLAINS REGION,
W69-06554 06B

CLEVELAND ELECTRIC ILLUMINATING CO., OHIO AND WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.
SUBSTATION EXPANSION, RELIABILITY, AND TRANSFORMER LOADING POLICY ANALYSIS,
W69-06685 06A

COLORADO STATE UNIV., FORT COLLINS.
A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
W69-06513 02J

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND IRRIGATION ENGINEERING AND AGRICULTURAL RESEARCH SERVICE, FORT COLLINS, COLO. SOIL AND WATER CONSERVATION RESEARCH DIV.
CONSERVATION OF SOIL WATER BY GRAVEL MULCHES,
W69-06796 03F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
EFFECTS OF TRUNCATION ON DEPENDENCE IN HYDROLOGICAL TIME SERIES,
W69-06789 02A

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, ASPENDALE (AUSTRALIA). DIV. OF METEOROLOGICAL PHYSICS.
TRANSPIRATION REDUCTION BY SURFACE FILMS,
W69-06532 03F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA).
EXTENDED TECHNIQUES OF CALCULATION OF SOIL-WATER MOVEMENT, WITH SOME PHYSICAL CONSEQUENCES,
W69-06714 02G

CONNECTICUT STATE HIGHWAY DEPT., WETHERSFIELD.
NON-ENGINEERING ELEMENTS IN FACTORS OF SAFETY IN SOIL AND FOUNDATION ENGINEERING,
W69-06695 08D

COOPERATIVE STATE RESEARCH SERVICE, WASHINGTON, D. C.
PROCEEDINGS OF TILE DRAINAGE RESEARCH CONFERENCE,
W69-06795 04A

CORNELL UNIV., ITHACA, N. Y.
A HEURISTIC AID FOR THE DESIGN OF SEWER NETWORKS,
W69-06498 05E

THE IMPROVEMENT OF WATER QUALITY UNDER A FINANCIAL CONSTRAINT A COMMENTARY ON 'LINEAR PROGRAMMING APPLIED TO WATER QUALITY MANAGEMENT',
W69-06547 05F

CORNELL UNIV., ITHACA, N. Y. DEPT. OF BOTANY.
APPLICATION OF AN ELECTRONIC PARTICLE COUNTER IN ANALYZING NATURAL POPULATIONS OF PHYTOPLANKTON,
W69-06540 07B

CORNELL UNIV., ITHACA, N. Y. SCHOOL OF CIVIL ENGINEERING.
EVALUATION OF SOME PRACTICAL METHODS OF ESTIMATING EVAPOTRANSPIRATION IN ARID CLIMATES AT LOW LATITUDES,
W69-06530 02D

CORNELL UNIV., ITHACA, N. Y. WATER RESOURCES AND MARINE SCIENCES CENTER.
PERMUTED TITLE INDEX TO WATER RESEARCH JOURNALS, 1967.
W69-06539 10

CORPS OF ENGINEERS, BUFFALO, N. Y.
FLOOD PLAIN INFORMATION, ROCKY RIVER IN CITIES OF ROCKY RIVER AND LAKEWOOD, CUYAHOGA COUNTY, OHIO.
W69-06468 04A

FLOOD PLAIN INFORMATION OF SENECA LAKE, NEW YORK.
W69-06825 04A

FLOOD PLAIN INFORMATION, CAYUGA LAKE, NEW YORK.
W69-06826 04A

FLOOD PLAIN INFORMATION, CANANDAIGUA LAKE, NEW YORK.
W69-06827 04A

CORPS OF ENGINEERS, CHICAGO, ILL.
WATER RESOURCES DEVELOPMENT IN MINNESOTA.
W69-06784 09D

CORPS OF ENGINEERS, FORT WORTH, TEX.
ARTIFICIAL RECHARGE TO THE EDWARDS LIMESTONE AQUIFER IN SOUTH TEXAS,
W69-06483 04B

CORPS OF ENGINEERS, JACKSONVILLE, FLA.
FLOOD PLAIN INFORMATION, GUAYANILLA RIVER, GUAYANILLA, PUERTO RICO.
W69-06473 04A

CORPS OF ENGINEERS, LITTLE ROCK, ARK.
FLOOD PLAIN INFORMATION, WILSON CREEK AND TRIBUTARIES, SPRINGFIELD, MISSOURI-PART 1.
W69-06467 04A

CORPS OF ENGINEERS, LOS ANGELES, CALIF.
FLOOD PLAIN INFORMATION OF SPRING VALLEY CREEK, SAN DIEGO COUNTY, CALIFORNIA.
W69-06824 04A

CORPS OF ENGINEERS, OMAHA, NEBR.
FLOOD PLAIN INFORMATION, OMAHA METROPOLITAN REGION, NEBRASKA - VOLUME 1.
W69-06471 04A

WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF

ENGINEERS IN COLORADO.
W69-06782 09D

CORPS OF ENGINEERS, PHILADELPHIA, PA.
WATER RESOURCES DEVELOPMENT BY THE US ARMY CORPS OF ENGINEERS IN DELAWARE.
W69-06783 09D

CORPS OF ENGINEERS, ROCK ISLAND, ILL.
FLOOD PLAIN INFORMATION, CEDAR RIVER, LINN COUNTY, IOWA.
W69-06472 04A

CORPS OF ENGINEERS, SACRAMENTO, CALIF.
HEC-2, WATER SURFACE PROFILES.
W69-06787 04A

HEC-3, RESERVIOR SYSTEM ANALYSIS.
W69-06788 04A

CORPS OF ENGINEERS, SEATTLE, WASH.
FLOOD PLAIN INFORMATION, YAKIMA RIVER, BENTON COUNTY, WASHINGTON.
W69-06470 04A

CORPS OF ENGINEERS, WALLA WALLA, WASH.
FLOOD PLAIN INFORMATION, WALLA WALLA RIVER TRIBUTARIES IN THE VICINITY OF WALLA WALLA, WASHINGTON.
W69-06469 04A

FLOOD PLAIN INFORMATION, BOISE RIVER AND NORTHSIDE TRIBUTARIES, BOISE, IDAHO AND VICINITY.
W69-06823 04A

DAMES AND MOORE, LOS ANGELES, CALIF.
A SIMPLIFIED TECHNIQUE FOR WELL-FIELD DESIGN,
W69-06421 02F

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO). PLANT RESEARCH INST.
THE PERFORMANCE OF SOIL MOISTURE ESTIMATES AS COMPARED WITH THE DIRECT USE OF CLIMATOLOGICAL DATA FOR ESTIMATING CROP YIELDS,
W69-06519 02G

DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.
CONSUMER ASPECTS OF PRICE INSTABILITY,
W69-06570 06C

DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA (ONTARIO). POLAR CONTINENTAL SHELF PROJECT.
A TEMPERATURE PROFILE THROUGH THE MEIGHEN ICE CAP, ARCTIC CANADA,
W69-06482 02C

DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA (ONTARIO). INLAND WATERS BRANCH.
A RIGID PLATE MODEL OF THE BAROMETRIC EFFECT,
W69-06775 02F

CLIMATOLOGY STUDIES OF BAFFIN ISLAND, NORTHWEST TERRITORIES,
W69-06814 02B

DEPARTMENT OF THE INTERIOR, WASHINGTON, D. C. AND CORPS OF ENGINEERS, WASHINGTON, D. C.
ALLOCATION AND REALLOCATION OF WATER RESOURCES,
W69-06691 06B

DEPARTMENT OF WATER DEVELOPMENT (KENYA).
RURAL WATER DEVELOPMENT IN KENYA,
W69-06453 04A

DOW CHEMICAL CO., WALNUT CREEK, CALIF.
RECOVERY OF SALTS FROM SALINE WATER VIA SOLVENT EXTRACTION (FINAL REPORT),
W69-06839 03A

DUKE UNIV., DURHAM, N. C.
COASTAL EROSION AND TRANSGRESSIVE STRATIGRAPHY,
W69-06798 02L

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). VERSUCHSANSTALT FUER WASSERBAU UND ERBAU.
RELATIONS BETWEEN GLACIER RUNOFF AND METEOROLOGICAL FACTORS OBSERVED ON AND OUTSIDE THE GLACIER,
W69-06481 02C

ELGIN INTERNATIONAL, INC.
SUL-BISUL(T) ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W69-06836 03A

ENVIRONMENTAL DATA SERVICE, SILVER SPRING, MD.
THE ABNORMALLY DRY WEATHER OF 1961-1966 IN THE NORTHEASTERN UNITED STATES,
W69-06437 02B

ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION, SILVER SPRING, MD.
SOME REMARKS ON THE PREDICTABILITY OF DROUGHT AND RELATED CLIMATIC ANOMALIES,
W69-06439 02B

FEATHER RIVER PROJECT ASSOCIATION, BAKERSFIELD, CALIF.
THE COMPETITION FOR WATER QUANTITY AGRICULTURE,
W69-06575 06D

FEDERAL INST. FOR SNOW AND AVALANCHE RESEARCH, WEISSFLUHJOCH DAVOS (SWITZERLAND).
DEFORMATION OF POLYCRYSTALLINE ICE UNDER COMBINED UNIAXIAL AND HYDROSTATIC PRESSURE,
W69-06475 02C

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, EDISON, N. J. NORTH ATLANTIC WATER QUALITY MANAGEMENT CENTER.
OIL AND HAZARDOUS MATERIALS-EMERGENCY PROCEDURES IN THE WATER ENVIRONMENT.
W69-06791 05G

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, D. C.
RESERVOIR MANAGEMENT THE TRADEOFF BETWEEN LOW-FLOW REGULATION AND FLOOD CONTROL,
W69-06496 04A

POLLUTION OF THE INTERSTATE WATERS OF THE BLACKSTONE AND TEN MILE RIVERS AND THEIR TRIBUTARIES,
W69-06802 05B

FISH AND WILDLIFE SERVICE, WASHINGTON D. C. AND BUREAU OF COMMERCIAL FISHERIES, WASHINGTON, D. C.
REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1968,
W69-06767 09C

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, ROME (ITALY).
FIELD OBSERVATIONS OF SOME PHYSICAL PROPERTIES IN ALLUVIAL SOILS OF ARID AND SEMI-ARID REGIONS,
W69-06515 02G

FOREST SERVICE (USDA), FORT COLLINS, COLO. ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION.
A SYSTEM FOR MAKING REMOTE AND UNDISTURBED MEASUREMENTS OF SNOW SETTLEMENT AND TEMPERATURES,
W69-06803 02C

FRESNO GROUND-WATER RECHARGE FIELD STATION, CALIF. SOUTHWEST BRANCH.
THE HYDROLOGIC AND GEOLOGIC ASPECTS OF A PERCHING LAYER - SAN JOAQUIN VALLEY, WESTERN FRESNO COUNTY, CALIFORNIA,
W69-06758 02F

GEOLOGICAL SURVEY, ARLINGTON, VA.
EFFECTS OF THE DROUGHT ON WATER RESOURCES-SURFACE AND SUBSURFACE HYDROLOGY,
W69-06440 02B

GROUNDWATER IN FRACTURED VOLCANIC ROCKS IN SOUTHERN ARIZONA,
W69-06831 02F

GEOLOGICAL SURVEY, AUSTIN, TEX.
WATER-QUALITY RECORDS FOR THE HUBBARD CREEK WATERSHED, TEXAS, OCTOBER 1966-SEPTEMBER 1967,
W69-06786 02H

GEOLOGICAL SURVEY, BATON ROUGE, LA.
RAINFALL-RUNOFF RELATIONS FOR SOUTHEASTERN LOUISIANA AND SOUTHWESTERN MISSISSIPPI,
W69-06829 02A

GEOLOGICAL SURVEY, CARSON CITY, NEV.
WATER-RESOURCES APPRAISAL OF THE LOWER MOAPA-LAKE MEAD AREA, CLARK COUNTY, NEVADA,
W69-06435 02F

GEOLOGICAL SURVEY, CARSON CITY, NEV., AND NEVADA STATE DEPT. OF CONSERVATION AND NATURAL RESOURCES.
ESTIMATED WATER USE IN NEVADA, 1950-65,
W69-06446 06D

GEOLOGICAL SURVEY, LUBBOCK, TEX.
PHOTOSYNTHESIS AND WATER USE BY SALTCEDAR,
W69-06771 03B

GEOLOGICAL SURVEY, MENLO PARK, CALIF.
RESPONSE OF BUBBLE-GAGE SERVOMANOMETERS TO OSCILLATIONS IN WATER LEVEL,
W69-06434 07C

GEOLOGICAL SURVEY, MONTPELIER, VT. AND VERMONT DEPT. OF NATURAL RESOURCES.
GROUND WATER FAVORABILITY MAP OF THE OTTAUQUECHEE-SAXTONS RIVER BASIN, VERMONT,
W69-06463 02F

GEOLOGICAL SURVEY, MONTPELIER, VT. AND VERMONT DEPT. OF WATER RESOURCES.
GROUND WATER FAVORABILITY MAP OF THE WEST-DEERFIELD RIVER BASIN, VERMONT,
W69-06464 02F

GROUND WATER FAVORABILITY MAP OF THE WELLS-OMPOMPANOOSUC RIVER BASIN, VERMONT,
W69-06465 02F

GROUND WATER FAVORABILITY MAP OF THE WHITE RIVER BASIN, VERMONT,
W69-06466 02F

GEOLOGICAL SURVEY, PHILADELPHIA, PA.
PRELIMINARY REMOTE SENSING OF THE DELAWARE ESTUARY,
W69-06793 02L

GEOLOGICAL SURVEY, RALEIGH, N. C.
ROLE OF GROUND WATER CONTAMINATION IN WATER MANAGMENT,
W69-06762 05G

GEOLOGICAL SURVEY, TRENTON, N. J.
GEOLOGY AND GROUND-WATER RESOURCES OF BURLINGTON COUNTY, NEW JERSEY,
W69-06449 02F

GEOLOGY AND GROUND-WATER RESOURCES OF THE RAHWAY AREA, NEW JERSEY,
W69-06450 02F

GEOLOGICAL SURVEY, WASHINGTON, D. C.
INFLOW TO SNAKE RIVER BETWEEN MILNER AND KING HILL, IDAHO,
W69-06427 02E

FLOOD INUNDATION AND EFFECTS OF URBANIZATION IN METROPOLITAN CHARLOTTE, NORTH CAROLINA,
W69-06445 04C

EXTENSIONS OF STREAMFLOW RECORDS IN UTAH,
W69-06447 02E

SUMMARY OF GROUND-WATER RESOURCES OF ATLANTIC COUNTY, NEW JERSEY,
W69-06448 02F

WATER LAWS AND CONCEPTS,
W69-06683 08E

DISTRIBUTION OF RADIONUCLIDES IN BOTTOM SEDIMENT OF THE CLINCH RIVER, EASTERN TENNESSEE,
W69-06785 05B

RECORDS OF WELLS AND TEST HOLES IN THE NEVADA TEST SITE AND VICINITY,
W69-06820 02F

GEORGE WASHINGTON UNIV., WASHINGTON, D. C.
IMPLICATIONS OF PROPERTY RIGHTS FOR GOVERNMENT INVESTMENT CHOICES,
W69-06548 06B

GEORGIA INST. OF TECH., ATLANTA.
POTASSIUM, ILLITE AND THE OCEAN,
W69-06506 02K

GEORGIA UNIV., ATHENS.
BRITTLE ROCK FAILURE UNDER TRIAXIAL STRESS,
W69-06701 08E

GRONINGEN RIJKSUNIVERSITEIT (NETHERLANDS) AND VIRGINIA UNIV., CHARLOTTESVILLE, VA.
A PARAMETRIC SIMPLICAL FORMULATION OF HOUTHAKKER'S CAPACITY METHOD,
W69-06568 06A

HARVARD UNIV., CAMBRIDGE, MASS.
THE OPPORTUNITY COSTS OF PUBLIC INVESTMENT,
W69-06739 06B

HARVARD UNIV., CAMBRIDGE, MASS. AND COLORADO RIVER BASIN PROJECT, DENVER.
ECONOMIC FRAMEWORK FOR SALINITY CONTROL PROJECTS,
W69-06490 05D

HEBREW UNIV., JERUSALEM (ISRAEL) GEOLOGICAL SURVEY OF ISRAEL, JERUSALEM AND CENTER FOR GROUNDWATER RESEARCH, JERUSALEM (ISRAEL).
THE GROUNDWATER PROVINCES OF IRAN,
W69-06772 04B

HEBREW UNIV., JERUSALEM (ISRAEL).
LONG-RUN COEFFICIENTS AND DISTRIBUTED LAG ANALYSIS A REFORMULATION,
W69-06557 06A

A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
W69-06715 02A

HEBREW UNIV., JERUSALEM (ISRAEL). DEPT. OF IRRIGATION.
MODERN IRRIGATION FOR INCREASED AGRICULTURAL PRODUCTION,
W69-06454 03F

HOKKAIDO UNIV., SAPPORO (JAPAN). INST. OF LOW TEMPERATURE SCIENCE.
THE METAMORPHISM OF WET SNOW,
W69-06477 02C

LIQUID PERMEABILITY OF SNOW,
W69-06478 02C

HORNER AND SHIFRIN, INC., CONS. ENGRS., ST. LOUIS, MO.
USE OF DIGITAL COMPUTERS IN DISTRIBUTION SYSTEM ANALYSES,
W69-06503 07C

HYDROMETEOROLOGICAL SERVICE OF THE USSR (MOSCOW).
DROUGHT AND SOIL MOISTURE,
W69-06529 02G

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND). DEPT. OF GEOLOGY.
A CLASSIFICATION OF PALEOCURRENT MODELS,
W69-06810 02J

INDIANA UNIV., BLOOMINGTON. DEPT. OF GEOLOGY AND INDIANA GEOLOGICAL SURVEY, BLOOMINGTON.
RANDOM PROCESSES AND LITHOLOGIC TRANSITIONS,
W69-06807 02J

INSTITUT DE PHYSIQUE DU GLOBE, STRASBOURG (FRANCE).
THE USE OF ELECTRIC ANALOG MODELS IN HYDRODYNAMICAL STUDY OF THE ALSACE AQUIFERS (FRENCH),
W69-06806 02F

INSTITUTE FOR DEFENSE ANALYSES, ARLINGTON, VA.
LEAST SQUARES, CONDITIONAL PREDICTIONS, AND ESTIMATOR PROPERTIES,
W69-06551 06A

INSTITUTE FOR GEOLOGICAL AND GEOPHYSICAL RESEARCH, BELGRADE (YUGOSLAVIA).
A CONTRIBUTION TO THE STUDY OF GROUNDWATER INTAKE RECHARGE IN KARST,
W69-06484 02F

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA (AUSTRIA).
THE ROLE OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IN THE DEVELOPMENT, USE AND CONTROL OF WATER RESOURCES.
W69-06456 03A

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT, NEW YORK AND OFFICE OF THE SECRETARY OF DEFENSE, WASHINGTON, D. C.
FIRST ORDER AUTO REGRESSION INFERENCE, ESTIMATION, AND PREDICTION,
W69-06550 06A

INTERNATIONAL BUSINESS MACHINES CORP., NEW YORK.
THE ESTIMATION OF NONLINEAR ECONOMETRIC SYSTEMS,
W69-06562 06A

IOWA STATE UNIV. OF SCIENCE AND TECHNOLOGY, AMES.
LINEAR PROBABILITY FUNCTIONS AND DISCRIMINANT FUNCTIONS,
W69-06563 06A

I-T-E IMPERIAL CORP., PHILADELPHIA, PA. AND CITY OF LOS ANGELES, CALIF.
SHUNT CAPACITOR ENERGIZATION WITH VACUUM INTERRUPTERS--A POSSIBLE SOURCE OF OVERVOLTAGE,
W69-06689 08C

KANSAS UNIV., LAWRENCE.
POTENTIAL OF RADAR REMOTE SENSORS AS TOOLS IN RECONNAISSANCE GEOMORPHIC, VEGETATION AND SOIL MAPPING,
W69-06718 07B

LAND-SEA INTERACTION LAB., NORFOLK, VA.
TREND SURFACE ANALYSIS OF SAND TRACER DISTRIBUTIONS ON A CARBONATE BEACH, BIMINI, BWI,
W69-06809 02L

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE (ENGLAND) AND OSAKA UNIV. (JAPAN). INST. OF SOCIAL AND ECONOMIC RESEARCH.
AN HARMONIC ANALYSIS OF NONSTATIONARY MULTIVARIATE ECONOMIC PROCESSES,
W69-06553 06A

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE (ENGLAND).
NONRECURSIVE MODELS AS DISCRETE APPROXIMATIONS TO SYSTEMS OF STOCHASTIC DIFFERENTIAL EQUATIONS,
W69-06571 06A

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT, CALIF.
CONTROL OF SEA-WATER INTRUSION IN A GROUND-WATER AQUIFER,
W69-06422 02F

MANCHESTER UNIV. (ENGLAND).
CIRCULAR AND LOGARITHMIC SPIRAL SLIP SURFACES,
W69-06694 08D

MANITOBA UNIV., WINNIPEG. DEPT. OF ACTUARIAL MATHEMATICS AND STATISTICS AND RESEARCH COUNCIL OF ALBERTA, EDMONTON. GROUNDWATER DIV.
ITERATIVE ANALYSIS BOUNDED LEAKY ARTESIAN AQUIFER,
W69-06508 02F

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
STREAMFLOW RECORD LENGTH FOR MODELLING CATCHMENT DYNAMICS,
W69-06781 02E

MCGILL UNIV., MONTREAL (QUEBEC).
SOILS STUDIES USING COLOR PHOTOS,
W69-06696 07B

MELBOURNE UNIV., PARKVILLE (AUSTRALIA). DEPT. OF METEOROLOGY AND MELBOURNE UNIV., PARKVILLE (AUSTRALIA). ANTARCTIC DIV.
THE ANNUAL HEAT ENERGY TRANSFER ABOVE AND INSIDE ANTARCTICA BLUE ICE,
W69-06480 02C

MICHIGAN STATE UNIV., EAST LANSING.
TENSION OF THE SOIL WATER WHEN PERMANENT WILTING OCCURS, AS MEASURED BY THE GRAY HYDROCAL HYGROMETER METHOD,
W69-06516 02G

TESTING SINGLE-EQUATION LEAST SQUARES REGRESSION MODELS FOR AUTOCORRELATED DISTURBANCES,
W69-06565 06A

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD, LOWESTOFT (ENGLAND). FISHERIES LAB AND FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, ROME (ITALY). FISHERIES BIOLOGY BRANCH.
A REVIEW OF THE LIFESPANS AND MORTALITY RATES OF FISH IN NATURE, AND THEIR RELATION TO GROWTH AND OTHER PHYSIOLOGICAL CHARACTERISTICS,
W69-06533 05C

MINISTRY OF AGRICULTURE, WAD MEDANI (SUDAN). RESEARCH DIV.
WATER USE BY IRRIGATED COTTON IN SUDAN. II. NET RADIATION AND SOIL HEAT FLUX,
W69-06756 03F

MINISTRY OF IRRIGATION AND POWER (INDIA).
CONSTRUCTION AND MANAGEMENT OF RIVER VALLEY PROJECTS IN

INDIA,
W69-06457 04A

BENEFICIAL USES OF WATERS OF INTERNATIONAL RIVERS INTERNATIONAL LAW AND PRACTICE,
W69-06458 06E

MISSOURI UNIV., COLUMBIA.
THE INFLUENCE OF OWNERSHIP AND CONTROL ON PROFIT RATES,
W69-06545 06B

NATIONAL INST. FOR AGRICULTURAL QUALITY TESTING BUDAPEST (HUNGARY).
SALT BALANCE AND SALT TRANSPORT PROCESSES IN IRRIGATED SOILS,
W69-06717 03F

NATIONAL SEVERE STORMS LAB., NORMAN, OKLA.
RADAR MEASUREMENT OF PRECIPITATION FOR HYDROLOGICAL PURPOSES,
W69-06812 02B

NATIONAL WATER SUPPLY RESEARCH LAB., WASHINGTON, D. C.
MICROBIAL PROBLEMS IN GROUNDWATER,
W69-06426 05C

NAVAL AIR STATION, MOFFET FIELD, CALIF. MINISTRY OF WORKS (SUDAN) AND WASHINGTON UNIV., SEATTLE.
SHEAR TRANSFER IN REINFORCED CONCRETE,
W69-06676 08F

NEVADA UNIV., RENO. DEPT. OF CIVIL ENGINEERING AND NEVADA UNIV., RENO. DESERT RESEARCH INST.
RECLAIMED WASTE WATER IN LAS VEGAS VALLEY,
W69-06832 05D

NEW ENGLAND RIVER BASINS COMMISSION, BOSTON, MASS.
SAFETY CONTROL OF PRIVATE DAMS,
W69-06433 04A

NEW SOUTH WALES UNIV., MANLY (AUSTRALIA). WATER RESEARCH LAB.
IMPROVED TECHNIQUES FOR ESTIMATING RUNOFF WITH BRIEF RECORDS,
W69-06830 02E

NEW YORK STATE DEPT. OF HEALTH, ALBANY. DIV. OF LABORATORIES AND RESEARCH.
ARSENIC ACCUMULATION BY FISH IN LAKES TREATED WITH SODIUM ARSENITE,
W69-06541 05B

NEW YORK UNIV., N. Y. DEPT. OF METEOROLOGY AND OCEANOLOGY.
DROUGHT IN THE NORTHEASTERN UNITED STATES,
W69-06436 02B

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION, RALEIGH.
A METHOD OF DETERMINING THE WATER POTENTIAL OF INTACT PLANTS,
W69-06527 02I

NORTH CAROLINA STATE UNIV., RALEIGH AND ISLAMABAD UNIV., RAWALPINDI (PAKISTAN).
THE USE OF ERROR COMPONENTS MODELS IN COMBINING CROSS SECTION WITH TIME SERIES DATA,
W69-06552 06A

NORTHWESTERN UNIV., EVANSTON, ILL.
CIVIL ENGINEERING AND URBAN SYSTEMS,
W69-06491 06A

NORWEGIAN GEOTECHNICAL INST., OSLO.
STABILIZATION OF UNDISTURBED QUICK CLAY BY SALT WELLS,
W69-06719 08D

OREGON STATE UNIV., CORVALLIS.
DYNAMIC SIMULATION MODEL OF THE TRANSPIRATION PROCESS,
W69-06504 02D

OREGON UNIV., EUGENE.
AGGREGATE KOYCK FUNCTIONS,
W69-06561 06B

OTAGO UNIV., DUNEDIN (NEW ZEALAND). DEPT. OF GEOGRAPHY.
ESTIMATION OF RAINFALL IN SPARSELY GAUGED AREAS,
W69-06773 02B

PENNSYLVANIA DEPT. OF HEALTH, HARRISBURG AND WEST VIRGINIA UNIV., MORGANTOWN.
EFFECTS OF MINE DRAINAGE ON GROUND WATER,
W69-06425 05C

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
CONCEPTUAL MODELS FOR CARBONATE AQUIFERS,
W69-06423 02F

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. INST. FOR RESEARCH ON LAND AND WATER RESOURCES.
THE HYDROLOGIC IMPORTANCE OF TRANSPIRATION CONTROL BY STOMATA,
W69-06520 02D

PLAN ORGANIZATION (IRAN). WATER PLANNING GROUP.
THE POSSIBILITY OF USING A MOVABLE DAM THE 'FABRIDAM' AND ITS APPLICATION IN ARID REGIONS,
W69-06455 04A

PRINCETON UNIV., N. J.
MAXIMIZATION BY QUADRATIC HILL-CLIMBING,
W69-06564 06A

PRINCETON UNIV., N. J. STANFORD UNIV., CALIF.
ON THE DISTRIBUTION OF STATISTICS SUITABLE FOR EVALUATING RAINFALL STIMULATION EXPERIMENTS,
W69-06679 03B

PURDUE UNIV., LAFAYETTE, IND.
MANPOWER REQUIREMENTS FOR POLLUTION CONTROL AND WATER RESOURCES IN INDIANA AND A RELATED POLLUTION CONTROL TECHNOLOGY CURRICULUM,
W69-06507 05G

INTERMOLECULAR FORCES AND THE LIQUID STATE,
W69-06838 01A

PURDUE UNIV., LAFAYETTE, IND. SCHOOL OF ENGINEERING AND PURDUE UNIV., LAFAYETTE, IND. DIV. OF CONFERENCES AND CONTINUATION SERVICES.
22 ND INDUSTRIAL WASTE CONFERENCE, 1967, PART ONE,
W69-06821 05D

RESEARCH COUNCIL OF ALBERTA, EDMONTON.
A COMPUTER-ORIENTED GROUND-WATER INFORMATION STORAGE AND RETRIEVAL SYSTEM,
W69-06764 07C

RESEARCH INST. FOR WATER RESOURCES DEVELOPMENT, BUDAPEST (HUNGARY).
TRACER METHOD FOR DETERMINING THE VELOCITY OF FLOW IN A CONFINED KARSTIC AQUIFER,
W69-06774 07B

RESOURCES FOR THE FUTURE, INC., WASHINGTON, D. C.
DESALTED SEAWATER FOR AGRICULTURE IS IT ECONOMIC,
W69-06765 03F

RESOURCES FOR THE FUTURE, INC., WASHINGTON, D. C. AND JOHNS HOPKINS UNIV., BALTIMORE, MD.
THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND AND ITS RELATION TO SYSTEM DESIGN AND PRICE STRUCTURE,
W69-06502 06D

RIVER FORECAST CENTER, HARRISBURG, PA.
RELATION OF A HYDROLOGIC INDEX TO MEAN ANNUAL FLOW,
W69-06441 02B

ROCHESTER INST. OF TECH., N. Y.
BEHAVIOR OF LIQUID SURFACES DURING EVAPORATION AND CONDENSATION,
W69-06840 03A

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N. J.
THE CES PRODUCTION FUNCTION A DERIVATION,
W69-06720 06B

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N. J. DEPT. OF ENVIRONMENTAL SCIENCES AND GEOLOGICAL SURVEY, WASHINGTON, D. C.
FACTORS INFLUENCING THE CONDENSATION OF 4-AMINOANTIPYRINE WITH DERIVATIVES OF HYDROXYBENZENE-III. A STUDY OF PHENOL CONTENT IN SURFACE WATERS,
W69-06444 05A

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT, CALIF. AND TRW SYSTEMS GROUP, REDONDO BEACH, CALIF.
SIGNIFICANCE OF GROUNDWATER MANAGEMENT STRATEGY-A SYSTEMS APPROACH,
W69-06424 06A

SANTA CLARA VALLEY WATER CONSERVATION DISTRICT, SAN JOSE, CALIF.
EFFECT OF SUBSIDENCE ON WELL FIELDS,
W69-06763 04B

SIERRA CLUB, SAN FRANCISCO, CALIF.
COMMENTS ON THE COMPETITION FOR WATER QUALITY AGRICULTURE,
W69-06576 06D

SIERRA HYDROTECHNOLOGY, PLACERVILLE, CALIF. AND ATMOSPHERIC WATER RESOURCES RESEARCH, FRESNO, CALIF.
REGIONAL HYDROLOGIC AREA STUDY AS AN ANALYSIS TOOL IN WEATHER MODIFICATION,
W69-06805 02A

SOUTH DAKOTA GEOLOGICAL SURVEY, VERMILLION AND GEOLOGICAL SURVEY, VERMILLION, S. DAK.
GEOLOGY AND HYDROLOGY OF CLAY COUNTY SOUTH DAKOTA-PART 1, GEOLOGY, AND PART 2, WATER RESOURCES,
W69-06486 02F

SOUTHERN ILLINOIS UNIV., CARBONDALE. DEPT. OF GEOLOGY.
GROUND WATER, GRAVITY AND RIFT VALLEYS IN MALAWI,
W69-06431 02F

SOUTHWEST RESEARCH INST., HOUSTON, TEX. AND TEXAS WATER DEVELOPMENT BOARD, AUSTIN.
THE POTENTIAL CONTRIBUTION OF DESALTING TO FUTURE WATER SUPPLY IN TEXAS.
W69-06558 03A

MANUAL OF PROCEDURES AND METHODS FOR CALCULATING COMPARATIVE COSTS OF MUNICIPAL WATER SUPPLY FROM SALINE AND CONVENTIONAL WATER SOURCES IN TEXAS,
W69-06559 03A

SOUTHWESTERN GREAT PLAINS RESEARCH CENTER, BUSHLAND, TEX.
EFFICIENT WHEAT IRRIGATION WITH LIMITED WATER,
W69-06511 03F

STANFORD UNIV., CALIF.
ESTIMATION OF RETURNS TO SCALE AND THE ELASTICITY OF SUBSTITUTION,

W69-06732 06B

STANFORD UNIV., CALIF. AND MOBIL OIL CO., PAULBORO, N. J.
OPTIMIZATION THEORY APPLIED TO PRELIMINARY DESIGN OF A SINGLE EFFECT MULTISTAGE FLASH DESALINATION PLANT,
W69-06495 03A

STANFORD UNIV., PALO ALTO, CALIF.
SPECIFICATION ANALYSIS IN THE ESTIMATION OF PARAMETERS OF A SIMULTANEOUS EQUATION MODEL WITH AUTOREGRESSIVE RESIDUALS,
W69-06567 06A

TAHAL CONSTRUCTION ENGINEERS LTD., TEL AVIV (ISRAEL).
PIPELINE PLANNING BY DYNAMIC COMPUTER PROGRAMMING,
W69-06493 06A

TAIWAN PROVINCIAL GOVERNMENT, TAIPEI. WATER CONSERVANCY BUREAU.
AGRICULTURE USE OF WATER IN TAIWAN, REPUBLIC OF CHINA,
W69-06460 03F

TECHNION - ISRAEL INST. OF TECH., HAIFA (ISRAEL) AND MINISTRY OF HOUSING (ISRAEL).
PREDICTION OF SWELLING PRESSURE OF CLAYS,
W69-06693 08D

TENNESSEE DEPT. OF PUBLIC HEALTH, NASHVILLE. STREAM POLLUTION CONTROL DIV.
STREAM POLLUTION CONTROL IN THE UPPER CUMBERLAND RIVER BASIN 1965.
W69-06488 05G

TEXAS A AND M UNIV., COLLEGE STATION. WATER RESOURCES INST.
WATER FOR TEXAS,
W69-06790 06B

TEXAS WATER DEVELOPMENT BOARD, AUSTIN AND WATER RESOURCES ENGINEERS, INC., LAFAYETTE, CALIF.
SYSTEMS SIMULATION FOR MANAGEMENT OF A TOTAL WATER RESOURCE.
W69-06494 04A

TRIDENT ENGINEERING ASSOCIATES, INC., ANNAPOLIS, MD.
CHESAPEAKE BAY CASE STUDY.
W69-06794 06B

UNIVERSITY COLL., CORK (IRELAND).
HYDROLOGIC CYCLE AS A CLOSED SYSTEM,
W69-06442 02A

UNIVERSITY COLL., LONDON (ENGLAND).
GRAPHIC DETERMINATION OF SLOPE AND OF DIP AND STRIKE,
W69-06681 07B

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA).
OPERATION OF MULTI-UNIT MULTI-PURPOSE WATER DEVELOPMENT SYSTEMS,
W69-06462 06D

UTAH STATE UNIV., LOGAN UTAH ENGINEERING EXPERIMENT STATION, SALT LAKE CITY AND UTAH WATER RESEARCH LAB., LOGAN.
EVAPORATION REDUCTION ON LARGE RESERVOIRS,
W69-06531 03F

UTAH WATER RESEARCH LAB., LOGAN.
ESTIMATING PAN EVAPORATION AND EVAPOTRANSPIRATION FROM CLIMATIC DATA,
W69-06522 02D

VIRGINIA POLYTECHNIC INST., BLACKSBURG, VA.
STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
W69-06500 05B

VIRGINIA POLYTECHNIC INST., BLACKSBURG.
WATER RESOURCES AND THE URBAN ENVIRONMENT,
W69-06428 04C

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DIV. OF AGRICULTURAL METEOROLOGY.
THE EFFECT OF CROP AND CLIMATIC FACTORS ON THE RADIATION BALANCE OF AN IRRIGATED MAIZE CROP,
W69-06757 03F

VSESOYUZNYI NAUCHNO-ISSLEDOVATELSKII INSTITUT GIDROTEKHNIKI I MELIORATSII, MOSCOW (USSR).
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W69-06716 03F

WASH UNIV., SEATTLE. DEPT. OF ATMOSPHERIC SCIENCES.
THE METAMORPHISM OF DRY SNOW AT A UNIFORM TEMPERATURE,
W69-06479 02C

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF ZOOLOGY AND WASHINGTON STATE UNIV., PULLMAN. DEPT. OF INFORMATION SCIENCE.
SIMULATION OF AN AQUATIC ECOSYSTEM,
W69-06536 02H

WASHINGTON UNIV., SEATTLE AND CALIFORNIA UNIV., SANTA BARBARA.
PUBLIC UTILITY PRICING AND OUTPUT UNDER RISK,
W69-06549 06C

WASHINGTON UNIV., SEATTLE.
SLUDGE DISPOSAL ALTERNATIVES -- SOCIO-ECONOMIC CONSIDERATIONS,
W69-06492 05E

WASHINGTON UNIV., SEATTLE. LAB. OF RADIATION ECOLOGY.
NICKEL-63 IN MARINE AND TERRESTRIAL BIOTA, SOIL, AND SEDIMENT,
W69-06766 05A

WATER PLANNING FOR ISRAEL LTD., HAIFA.
IRRIGATION WATER SYSTEM--ISRAEL'S NATIONAL WATER GRID,
W69-06459 03F

WATER RESOURCES COUNCIL, WASHINGTON, D. C.
INTERGOVERNMENTAL PLANNING OF WATER RESOURCES,
W69-06429 06B

WATER RESOURCES ENGINEERS, INC., LAFAYETTE, CALIF. AND CALIFORNIA UNIV., BERKELEY.
WATER QUALITY MANAGEMENT IN IRRIGATION SYSTEMS,
W69-06499 05G

WEATHER BUREAU, SILVER SPRING, MD. OFFICE OF HYDROLOGY.
FREQUENCY AND AREAL DISTRIBUTIONS OF TROPICAL STORM RAINFALL, U.S. COASTAL REGION, GULF OF MEXICO,
W69-06797 02B

WEATHER BUREAU, WASHINGTON, D. C. EXTENDED FORECAST DIV.
FURTHER STUDIES OF DROUGHT OVER NORTHEASTERN UNITED STATES,
W69-06438 02B

WEIZMANN INST OF SCIENCE, REHOVOTH (ISRAEL). DEPT. OF ISOTOPES.
THE STABLE ISOTOPE COMPOSITION OF MINERAL WATERS IN THE JORDON RIFT VALLEY, ISRAEL,
W69-06750 02F

WEIZMANN INST. OF SCIENCE, REHOVOTH (ISRAEL) ISRAEL ATOMIC ENERGY COMMISSION, REHOVOTH AND GEOLOGICAL SURVEY OF ISRAEL, JERUSALEM. HYDROGEOLOGICAL DIV.
GEOCHEMICAL TRACING OF MINERAL WATER SOURCES IN THE SOUTH WESTERN DEAD SEA BASIN, ISRAEL,
W69-06747 02F

WEIZMANN INST. OF SCIENCE, REHOVOTH (ISRAEL) ISRAEL ATOMIC ENERGY COMMISSION, REHOVOTH AND WATER PLANNING FOR ISRAEL LTD., HAIFA.
GEOCHEMICAL TRACING OF MINERAL AND FRESH WATER SOURCES IN THE LAKE TIBERIAS BASIN, ISRAEL,
W69-06748 02F

THE ORIGIN OF THE TIBERIAS-NOIT MINERAL WATER ASSOCIATION IN THE TIBERIAS-DEAD SEA RIFT VALLEY, ISRAEL,
W69-06749 02F

WEST BASIN MUNICIPAL WATER DISTRICT, HERMOSA BEACH, CALIF.
THE COMPETITION FOR WATER QUANTITY INDUSTRY,
W69-06577 06D

WESTINGHOUSE ELECTRIC CORP., EAST PITTSBURGH, PA. AND MONONGAHELA POWER CO., FAIRMONT, W. VA.
OPEN BREAKER PROTECTION OF EHV SYSTEMS,
W69-06688 08C

WISCONSIN UNIV., MADISON.
CALCULATION OF BALANCED AND UNBALANCED FAULT CURRENTS IN AC-DC POWER SYSTEMS,
W69-06690 08C

THE ROLE OF ALTERNATIVE COST IN PROJECT DESIGN AND SELECTION,
W69-06738 06B

CHOOSING AMONG ALTERNATIVE PUBLIC INVESTMENTS IN THE WATER RESOURCE FIELD,
W69-06740 06B

WISCONSIN UNIV., MADISON. DEPT. OF ZOOLOGY.
SPECIES DIVERSITY AND COMMUNITY STRUCTURE IN LACUSTRINE PHYTOPLANKTON,
W69-06542 02H

WISCONSIN UNIV., MADISON. WATER CHEMISTRY LAB.
THE AGING OF LAKES,
W69-06535 02H

ACCESSION NUMBER INDEX

02F	W69-06421	05E	W69-06498	08H	W69-06581	06E	W69-06662
02F	W69-06422	05G	W69-06499	03A	W69-06582	06E	W69-06663
02F	W69-06423	05B	W69-06500	03A	W69-06583	06E	W69-06664
06A	W69-06424	06D	W69-06502	06E	W69-06584	06E	W69-06665
05C	W69-06425	07C	W69-06503	06E	W69-06586	06E	W69-06666
05C	W69-06426	02D	W69-06504	06E	W69-06587	06E	W69-06667
02E	W69-06427	05D	W69-06505	06E	W69-06588	06E	W69-06668
04C	W69-06428	02K	W69-06506	06E	W69-06589	06E	W69-06669
06B	W69-06429	05G	W69-06507	06E	W69-06590	06E	W69-06670
02F	W69-06430	02F	W69-06508	06E	W69-06591	06E	W69-06671
02F	W69-06431	02F	W69-06509	06E	W69-06592	08F	W69-06672
04A	W69-06433	02G	W69-06510	06E	W69-06593	08E	W69-06673
07C	W69-06434	03F	W69-06511	06E	W69-06594	08D	W69-06674
02F	W69-06435	02G	W69-06512	06E	W69-06595	05G	W69-06675
02B	W69-06436	02J	W69-06513	06E	W69-06596	08F	W69-06676
02B	W69-06437	02G	W69-06514	06E	W69-06597	08A	W69-06677
02B	W69-06438	02G	W69-06515	06E	W69-06598	08F	W69-06678
02B	W69-06439	02G	W69-06516	06E	W69-06599	03B	W69-06679
02B	W69-06440	02F	W69-06517	06E	W69-06600	02E	W69-06680
02B	W69-06441	02G	W69-06519	06E	W69-06601	07B	W69-06681
02A	W69-06442	02D	W69-06520	06E	W69-06602	08F	W69-06682
02B	W69-06443	02D	W69-06522	06E	W69-06603	08E	W69-06683
05A	W69-06444	02G	W69-06523	06E	W69-06604	08C	W69-06684
04C	W69-06445	02G	W69-06524	06E	W69-06605	06A	W69-06685
06D	W69-06446	02D	W69-06526	06E	W69-06606	08C	W69-06686
02E	W69-06447	02I	W69-06527	06E	W69-06607	08C	W69-06687
02F	W69-06448	02G	W69-06528	06E	W69-06608	08C	W69-06688
02F	W69-06449	02G	W69-06529	06E	W69-06609	08C	W69-06689
02F	W69-06450	02D	W69-06530	06E	W69-06610	08C	W69-06690
02E	W69-06451	03F	W69-06531	06E	W69-06611	06B	W69-06691
02F	W69-06452	03F	W69-06532	06E	W69-06612	08D	W69-06692
04A	W69-06453	05C	W69-06533	06E	W69-06613	08D	W69-06693
03F	W69-06454	02H	W69-06535	06E	W69-06614	08D	W69-06694
04A	W69-06455	02H	W69-06536	06E	W69-06615	08D	W69-06695
03A	W69-06456	06A	W69-06537	06E	W69-06616	07B	W69-06696
04A	W69-06457	02K	W69-06538	06E	W69-06617	07B	W69-06697
06E	W69-06458	10	W69-06539	06E	W69-06618	08C	W69-06698
03F	W69-06459	07B	W69-06540	06E	W69-06619	08D	W69-06699
03F	W69-06460	05B	W69-06541	06E	W69-06620	08A	W69-06700
04A	W69-06461	02H	W69-06542	06E	W69-06621	08E	W69-06701
06D	W69-06462	06B	W69-06545	06E	W69-06622	07B	W69-06702
02F	W69-06463	05F	W69-06547	06E	W69-06623	04D	W69-06704
02F	W69-06464	06B	W69-06548	06E	W69-06624	08E	W69-06706
02F	W69-06465	06C	W69-06549	06E	W69-06625	08C	W69-06707
02F	W69-06466	06A	W69-06550	06E	W69-06626	08C	W69-06708
04A	W69-06467	06A	W69-06551	06E	W69-06627	08C	W69-06709
04A	W69-06468	06A	W69-06552	06E	W69-06628	08C	W69-06710
04A	W69-06469	06A	W69-06553	06E	W69-06629	08F	W69-06711
04A	W69-06470	06B	W69-06554	06E	W69-06630	08F	W69-06712
04A	W69-06471	03A	W69-06555	06E	W69-06631	08B	W69-06713
04A	W69-06472	03C	W69-06556	05G	W69-06632	02G	W69-06714
04A	W69-06473	06A	W69-06557	06E	W69-06633	02A	W69-06715
02C	W69-06474	03A	W69-06558	06E	W69-06634	03F	W69-06716
02C	W69-06475	03A	W69-06559	06E	W69-06635	03F	W69-06717
02C	W69-06476	06A	W69-06560	06E	W69-06636	07B	W69-06718
02C	W69-06477	06B	W69-06561	06E	W69-06638	08D	W69-06719
02C	W69-06478	06A	W69-06562	06E	W69-06639	06B	W69-06720
02C	W69-06479	06A	W69-06563	06E	W69-06641	06B	W69-06721
02C	W69-06480	06A	W69-06564	06E	W69-06642	06C	W69-06722
02C	W69-06481	06A	W69-06565	06E	W69-06643	05D	W69-06723
02C	W69-06482	06D	W69-06566	06E	W69-06644	06B	W69-06724
04B	W69-06483	06A	W69-06567	06E	W69-06645	06B	W69-06725
02F	W69-06484	06A	W69-06568	06E	W69-06646	06B	W69-06726
02F	W69-06485	06A	W69-06569	06E	W69-06647	06D	W69-06727
02F	W69-06486	06C	W69-06570	06E	W69-06648	06B	W69-06728
04B	W69-06487	06A	W69-06571	06E	W69-06649	06B	W69-06729
05G	W69-06488	06B	W69-06572	06E	W69-06650	06B	W69-06730
02G	W69-06489	06D	W69-06573	06E	W69-06652	05G	W69-06731
05D	W69-06490	06D	W69-06574	06E	W69-06653	06B	W69-06732
06A	W69-06491	06D	W69-06575	06E	W69-06655	06B	W69-06733
05E	W69-06492	06D	W69-06576	06E	W69-06656	06B	W69-06734
06A	W69-06493	06D	W69-06577	06E	W69-06657	06B	W69-06735
04A	W69-06494	06D	W69-06578	06E	W69-06658	06B	W69-06738
03A	W69-06495	06E	W69-06579	06E	W69-06660	06B	W69-06739
04A	W69-06496	06E	W69-06580	06E	W69-06661	06B	W69-06740

02J	W69-06746	02B	W69-06773	02J	W69-06799	05D	W69-06821
02F	W69-06747	07B	W69-06774	05B	W69-06802	02A	W69-06822
02F	W69-06748	02F	W69-06775	02C	W69-06803	04A	W69-06823
02F	W69-06749	02E	W69-06781	02B	W69-06804	04A	W69-06824
02F	W69-06750	09D	W69-06782	02A	W69-06805	04A	W69-06825
03F	W69-06756	09D	W69-06783	02F	W69-06806	04A	W69-06826
03F	W69-06757	09D	W69-06784	02J	W69-06807	04A	W69-06827
02F	W69-06758	05B	W69-06785	02C	W69-06808	02A	W69-06829
02F	W69-06759	02H	W69-06786	02L	W69-06809	02E	W69-06830
05G	W69-06762	04A	W69-06787	02J	W69-06810	02F	W69-06831
04B	W69-06763	04A	W69-06788	07B	W69-06811	05D	W69-06832
07C	W69-06764	02A	W69-06789	02B	W69-06812	02D	W69-06833
03F	W69-06765	06B	W69-06790	02F	W69-06813	06A	W69-06834
05A	W69-06766	05G	W69-06791	02B	W69-06814	02E	W69-06835
09C	W69-06767	02L	W69-06793	02F	W69-06815	03A	W69-06836
02J	W69-06768	06B	W69-06794	02F	W69-06816	03A	W69-06837
09C	W69-06769	04A	W69-06795	02F	W69-06817	01A	W69-06838
04C	W69-06770	03F	W69-06796	02F	W69-06818	03A	W69-06839
03B	W69-06771	02B	W69-06797	02F	W69-06819	03A	W69-06840
04B	W69-06772	02L	W69-06798	02F	W69-06820		

ABSTRACT SOURCES

	Accession Numbers	Total
A. Centers of Competence:		
(1) U.S. Geological Survey - Hydrology	W69-06421 -- W69-06489 W69-06765 -- W69-06835	130
(2) Cornell University - Policy Models for Water Resource Systems	W69-06490 -- W69-06505	14
(3) University of Arizona - Arid Lands Water Resources	W69-06508 -- W69-06532 W69-06746 -- W69-06764	34
(4) University of Wisconsin - Eutrophication	W69-06533 -- W69-06542	9
(5) Rutgers University - Water Resources Economics	W69-06545 -- W69-06583 W69-06720 -- W69-06740	57
(6) Bureau of Reclamation - Engineering Works	W69-06672 -- W69-06719	46
(7) University of Florida - Eastern U.S. Water Law	W69-06586 -- W69-06671 W69-06584	82
B. Other Sources:		
(1) Georgia Institute of Technology - Water Resources Center	W69-06506	1
(2) Purdue University - Water Resources Research Center	W69-06507	1
(3) Office of Saline Water	W69-06836 -- W69-06840	5
	Grand Total	379

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

0 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

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